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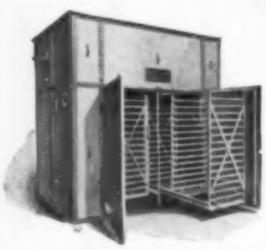

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CHEMICAL & METALLURGICAL ENGINEERING

H. C. PARMELEE
Editor

Volume 31 | New York, October 20, 1924 | Number 16

What About Oil Shale?

SOME of our friends in the petroleum industry have expressed a rather disinterested attitude toward oil-shale development. They ask: "Why should we worry about oil shale when we have more oil now than we can handle at a profit? New fields are coming in every day and the end is not yet in sight. Oil shale is for our children or our children's children, but surely it is not for us."

A few days ago the director of the United States Geological Survey pointed out—perhaps a bit more forcibly than has been done repeatedly by his contemporary economists—that our present oil industry is but a frenzy of exploitation. Petroleum is a wasted as well as wasting resource. The supply is not inexhaustible and every field that splurges forth with its flood of oil brings us just that much nearer the day when we must look to other sources for our supplies of liquid fuels.

But it is not our purpose here to defend either viewpoint. He is indeed a brave man who would venture any prediction on the future of petroleum production. The fact remains, however, that in the minds of many engineers oil shale is a questionable if not a dead issue. The reason for this unsympathetic and wholly unwarranted attitude is to be found in the brief history of oil-shale development. Beginning 10 years ago when the tremendous resources of the Rocky Mountain district first came to the public's attention, there was a rising wave of interest and enthusiasm that seemed to presage great things for oil shale. No industry was ever better advertised, and yet the truth of the matter is that as an industry it has failed to arrive. The general business depression of 1921 and an overproduction of petroleum combined to wreck the high hopes of the oil-shale pioneers. This was not the sole cause for the collapse, however, for the unscrupulous promoter and the unprincipled propagandist also contributed to oil shale's meteoric rise and fall. But the most important reason lies in the fact that in the frenzied urge for exploitation there was not a proper appreciation of the need for technology. Had the development been based on science and sound engineering practice, progress might not have been so spectacular, but certainly it would have been of a more permanent character. Fortunately there are several recent indications of a return of interest in oil shale. In this revival the technologist is to play an increasingly important rôle. It is to him that the industry must look for its progress.

This is one of the conclusions the reader will draw from a series of articles on oil-shale development, the first of which appears in the current issue. A member of *Chem. & Met.'s* editorial staff reports therein impressions he has gained from a first-hand study of our oil-shale resources and of the progress that has been made toward their commercial exploitation. The series, which will give attention both to the economic and to the technical problems, should prove of value, we believe, to all who may have a part in the development of a great chemical engineering industry of the future.

Ford Withdraws His Offer

IT IS important news, if true, that Henry Ford has decided to withdraw his bid for Muscle Shoals. The automobile manufacturer has been the storm center of Muscle Shoals controversy ever since he first entered the lists, and his withdrawal is likely to do more than anything else we can think of to pave the way for dispassionate consideration of the best disposition of this government property. The Ford offer has attracted attention and received consideration out of all proportion to its importance, except perhaps in one particular —namely, the arousing of public interest in the actual and potential value of Muscle Shoals and the stimulation of other bids on the part of industrial and power companies. We have previously commented on the probability that in the final settlement of the question Mr. Ford would be found to have served as a catalyst. If this proves to be the case, he will have rendered a public service that will in large measure justify the controversy of the past few years.

From Washington we learn that while the withdrawal of the offer took the capital by surprise, the general opinion is that Mr. Ford realized that his bid was doomed to defeat. There is also general concurrence in the view that the government has lost only its lowest bidder. It has been evident for some time that the Ford offer had lost its earlier impetus. At the hearings before the Senate committee during the last session of Congress, some of the early supporters of the Ford plan became lukewarm. The American Farm Bureau, in particular, which was a factor in inducing Mr. Ford to make his offer, became convinced that it was not the best among those finally submitted. When witnesses were on the stand before the Norris committee, Senator Heflin, the most rampant of the Ford supporters, was absent, and Senator Harrison, another proponent, asked only a few perfunctory questions. These were the early indications that Ford support was weakening, and since that time the trend has been progressively away from Ford and toward the other bidders. It has even been established that no fewer than 70 votes in the Senate would have been cast against the Ford offer if it had come before that body at the last session.

Muscle Shoals bills are on the calendar for early consideration in December. It seems unlikely that so

technical a matter will be handled intelligently in the halls of Congress, but a better method of disposition has not yet been decided upon. The President still favors his joint commission to negotiate for the lease or sale of the property, and Mr. Hoover is said to have proposed a committee of technical men to advise the Congressional commission. At the time of writing there is no outstanding feature of the whole situation except that the withdrawal of the Ford offer has cleared the way for a comparative consideration of other offers that are not so highly controversial in character.

No Time For Frills

LITTLE incidents sometimes betray marked personal characteristics. At a private dinner party recently given in honor of a great industrial leader he revealed a trait that undoubtedly has contributed largely to his success—namely, the habit of setting aside frills and non-essentials and going directly at the matter in hand. The dinner was elegantly appointed and the service beyond criticism. The first course was grape fruit fashioned in the form of a basket with a red ribbon neatly tied on the handle. Another bit of color was added by maraschino cherries, and taken as a whole the creation was one to delight the eye of a connoisseur. But apparently the æsthetic effect was lost upon our eminent, practical and direct-minded guest, who saw before him something to eat with certain obstacles in the way of the practical enjoyment of his food. His first act therefore was to seize a knife and cut off the handle and ribbon, setting them aside with the comment "We'll get these frills out of the way so we can get at it." A meticulous host might have been dismayed at this unconventional behavior, but those who observed the incident saw in it only another expression of a characteristic that had made the man pre-eminent in his industry. In business as well as in social affairs he had always set frills aside so that direct action would not be impeded.

Data Are Lacking— Who Is To Blame?

RECENTLY a representative of one of the big chemical engineering groups in American industry inquired of the editors of *Chem. & Met.* regarding the best available data on a subject of great interest to his company. We knew that ordinarily the facts could best be obtained from government statistics commonly available in the spring of each year; but we discovered that in this particular case the government had not yet been able to complete its report for 1923 even as late as October, 1924. Inquiry as to the cause of delay developed the fact that the particular corporation asking us for the figures was the only one delinquent in making its report to the government for the calendar year 1923!

Undoubtedly the technical staff of this corporation was not at fault in delaying its statistical report to the government. Engineers are too familiar with the importance of government figures to allow their own convenience to interfere with reasonably prompt returns on the annual government questionnaires. In the particular case in question we believe it was a mistaken policy on the part of management officials that caused delay. And it is even more certain that the same officials are the very ones that will suffer by their own attitude. They will not be able to get the desired accurate basis of estimate for next year's business, because last year's data remain pure guesses in important particulars. In this respect they are the authors of their own predicament and will receive scant sympathy.

Possibly there are delinquents in other industries that could just as well as not co-operate promptly with government agencies. Any who are in that class will do well immediately to make amends for their delay by completing the returns that have been asked of them. It is hoped that the flagrant example just cited may stimulate all to make more prompt returns next year.

Do You Know Your Competitor?

SOME TIME ago the producers in a certain industry, numbering not more than half a dozen, felt the need of a more complete knowledge of the production of the industry as a whole. Each of them felt that he could conduct his business more intelligently if he had some measure of the part he was playing. The situation was similar to that which exists in many large industries, in which a trade association is set up as a clearing house for economic information on the whole industry. In the case in question, however, the industry was small and unorganized and *Chem. & Met.* was asked to serve as a clearing house, receiving the figures of each producer, compiling them and returning only the totals.

Prior to this incident the members of this industry had never before worked together in any common cause. They had not even been personally acquainted and there was little or no intercourse among them. Subsequently the individual who was responsible for the plan not only expressed his gratification at the successful way in which it was carried out but also gave his opinion that one of the most valuable byproducts was the personal acquaintance that had been formed among the competitors. Each had found that the others were human, likable, honest and entitled to respect. It is an old story but worthy of repetition. It is a good thing to know your competitor, because you will usually discover in him a good fellow with quite as high aims, hopes and ambitions as your own. And without abandoning any of the elements of competition with him you can usually find some common ground on which to start and work for the industry as a whole.

Wanted— Small Unit-Process Equipment

CHEMICAL equipment manufacturers are frequently approached these days by those who want small-size unit-process apparatus for educational or research purposes. Many manufacturers have been farsighted enough to see that this is not simply an annoying diversion from standard manufacturing requirements, but rather a clear evidence of progress in the use of their equipment. They have set about the development and production of this small-unit equipment, such as filter presses, steam-jacketed kettles, vacuum pans, etc., and are profiting by a service which at first appeared to be a liability rather than an asset.

There is a place in any educational institution teaching chemical engineering for a well-equipped unit-

process laboratory. No student can be adequately trained by lecture, quiz and plant inspection trips alone; he must also have laboratory contact with equipment on a small scale. The manufacturer who makes it easy for the professor of chemical engineering so to fit up his laboratory as to teach the student the use of equipment is bound to profit thereby, for there is a strong likelihood that in his later professional experience the student will choose the manufacturer's equipment on which he learned the first principles of plant operation.

But it is not alone in the educational institution that these small unit-process devices are needed. The industrial research laboratory is more and more finding it necessary to become also a preliminary development laboratory in order to carry the research conclusion one step closer to plant scale production. The development laboratory or experimental department of a plant can rarely afford to try out its new problems for the first time on plant-scale equipment. In those plants there is, therefore, need of small unit-process apparatus that will take 100-lb. or 10-gal. lots in contrast with the ton or 1,000-gal. lots which become the units of plant operation.

There is but one answer to this demand: The preparation of small unit-process equipment as a regular part of the commercial line of machinery offered to industry. There may be no immediate profit in the sale of the devices, but a successful small unit is a better salesman than can be sent out for equivalent cost in any other way.

To Wage War On Decay

DECAY is to wood what corrosion is to metal, and the problems of preventing decay are almost as important, technically and economically, as are those of avoiding corrosion. And yet wood decay has not received the attention it deserves nor has wood preservation been given the technical prominence to which it is entitled as a potential chemical engineering industry. Corrosion can afford to take a back seat temporarily while we emphasize decay, its tremendous cost to industry and its prevention.

Prevention of decay is intimately related to the conservation of our forests, because it constitutes by far the greatest preventable destruction of wood products. It is necessary only to make a casual observation to get some slight conception of the fact that decay is the largest single cause of the destruction of wood requiring replacement. Tanks and vats, towers and pipes, roofs and flooring, trestles and ties, bridges, piling and docks, all require occasional renewal due to decay, and put a tremendous drain on our forests.

The prevention of decay by the treatment of wood, other than coating it with paint, is a chemical engineering problem, and it is in this connection that chemical engineers will find an important point of contact with the conference that has been called by the Secretary of Agriculture to discuss the better utilization of forest products. As the question of timber supply becomes more acute it is necessary to consider not only methods of reforestation, which are long-time processes, but more particularly methods for protecting our present wood supply from the inroads of fire, disease and decay. It is a timely movement on the part of the Department of Agriculture to call together all of the industries having an interest in wood so that the problem may be studied as a whole and every influence brought to bear on its solution. Chemical engineering should play an important part in the deliberations in Washington on Nov. 19 and 20. While the chemical preservation of wood is already an established industry, it still offers a field for expansion and particularly for the development of new methods, new preservatives and cheaper and more efficient treatment. The fight against decay is worthy of our best efforts.

Disposal of Waste Must Be Studied

ONE well-known sanitary engineer remarks, with some justification, that "our chemical engineers go out with the idea that it is perfectly legitimate to dump anything from condenser water to cyanide into any stream and forget it. That attitude will certainly have to be revised in the next 10 years." Doubtless there are exceptions to this sweeping generalization, but unfortunately the criticism is often a proper one.

With increasing size of industrial establishments and increasing density of population, the problem has become too serious to permit its continued neglect in the future. Good water supply is just as important in most plants as competent help. Therefore it should be obvious to the management and to the technical staff that it is unfair to the man downstream to dump plant wastes promiscuously into nearby waters. Only the man who is fortunate enough to have a whole ocean at his sewer outlet can afford to be careless regarding waste disposal, and even here the problem of protecting coastal fisheries, bathing beaches and shipping necessitates some thought for the other fellow.

Many industries have learned to their sorrow of the distressing reputation and actual financial loss incident to carelessness in waste disposal. They now appreciate the effort to maintain a good water supply and welcome the sanitary engineer who tells them what they must do to avoid being a nuisance. The recent meeting of the water supply and sanitary chemists at Ithaca emphasized some points along this line that demand attention. Whether the problem is apparently simple or not, the advice of a specialist will probably make for economy in the end.

Significance of The Arrival of ZR-3

EVENTS bearing on international amity and accord have moved swiftly in the past few weeks. The Dawes plan was formally put into effect, the international loan to Germany was oversubscribed in England and the United States, and last but not least, the ZR-3 made a historic and record-breaking trip from Friedrichshafen to Lakehurst.

In the successful flight of the great Zeppelin dirigible the world has seen much more than a triumph of science and engineering *per se*. It was a fine example of the incidence of science and engineering on civilization, on the spread of knowledge, on the removal of the physical limitations of time and space, and on the closer accord of the nations of the world. Press messages report the most inspiriting manifestation of pride and joy that has seized the German populace in many a year, while the demonstration in this country was only less animated on account of the early hour of the ship's arrival.

Future Centers for an American Oil-Shale Industry

DeBeque and Grand Valley, Colorado, nestling in picturesque surroundings at the base of the great shale cliffs of the Green River formation, are generally regarded as the logical centers for oil-shale development. The comparative recent geology of this region is well shown in these views. Among the interesting topographical features will be seen the effect of primary erosion in the foot hills, the sheer faces of the shale cliffs and the high plateaus of the top country. All of these features have an important bearing on the mining and retorting of the oil shale.

What About Oil Shale?

A Brief Survey of Our Vast Resources and a History of Their Development Form the Basis of the First of Several Articles on the Economics and Technology of Oil Shale

By Sidney D. Kirkpatrick
Assistant Editor, *Chem. & Met.*

> Much has been published about oil shale that is untrue or misleading. Promoters interested in personal gain or well-meaning propagandists hoping to speed the development of a great natural resource have built up an enormous oil-shale "literature" that for the most part has defeated its own purposes.
>
> Last summer *Chem. & Met.* sent Mr. Kirkpatrick to the shale fields to learn first hand of the progress being made in the development of these resources that may some day form the basis of a great chemical engineering industry. His investigation forms the basis of a comprehensive series of articles, the first of which appears in this issue. In it the resources are described and the history of their development is briefly sketched.

IT IS almost trite to refer to oil shale as America's second line of defense in the future contest for a domestic supply of liquid fuel. Yet I like to think of those tremendous reserves—particularly the miles upon miles of massive cliffs in the Green River district of Colorado, Utah and Wyoming—as a mighty bulwark against the oil famine that sooner or later this nation must face. Even the casual visitor to this region cannot help but be impressed by what appears and in reality amounts to an almost inexhaustible resource.

Fortunately no country has a monopoly on oil shale, for this mineral is of wide occurrence. Best known, of course, are the Scottish deposits that have been worked on a large scale for 75 years, but oil shale has also received attention in France, England, Australia, Canada and other countries. In the United States there is the Eastern field—Pennsylvania, New York, Ohio, Indiana, Illinois and Kentucky—which is older geologically but somewhat inferior both in quality and quantity to the Western field of the Rocky Mountain region. It is particularly the Green River formation of northwestern Colorado, northeastern Utah and southwestern Wyoming that has had most attention, and because of the unusual richness and extent of this resource it has come to be regarded as the logical center for future oil-shale development. Workable deposits in Nevada, notably at Elko, and in California and Montana have also received attention; in fact, it is at the first-named locality that to date most progress toward commercial exploitation of American oil shale has been made.

In the present article interest will be directed principally to the shales of Colorado, Utah, Wyoming and Nevada. Geologically these deposits, which are sedimentary in origin, were formed during the Tertiary and Cretaceous periods, in contrast with the Eastern shales, of the Devonian and Carboniferous ages. As the topography of the Green River formation has been carved out by the principal rivers of the district—Grand of Colorado, Green, White, Duchesne and their tributaries—the deposits appear as cliffs and rugged peaks backed by the plateaus of the top country perhaps 1,000 to 2,500 ft. above the river valleys. In many places the outcrops along the steep-walled canyons are of shale, all of which is oil-yielding, although certainly not of uniform richness nor of workable quality. Surface samples taken at frequent intervals down the perpendicular face of the outcrops usually show an oil content varying from 5 to 65 gal. of oil per ton. These findings have been confirmed in a few instances by core drillings that show uniform beds often 50 ft. in depth which will average 35 gal. to the ton, while 20-ft. veins that will yield 60 gal. are not uncommon. Thin layers may often be found that by laboratory tests will give 90 to 100 gal. of crude oil per ton of shale, although these are not regarded as of unusual economic significance. The oil-yielding strata lie in practically a horizontal plane and are remarkably persistent throughout the entire deposit.

Perhaps it should have been pointed out previously that the term oil shale is in reality a misnomer. The rock does not contain oil *per se*, as in the case of oil sand or the saturated shales of the oil fields. Rather it contains the oil-forming organic substance known as kerogen, which on heating is transformed first into a bituminous material and then into crude shale oil. The oil-yielding shales of the Green River district are of three principal types—so-called papery, massive and curly varieties—although there are many gradations and classification is not always easy.

Very often one is asked the rather natural question: What is the estimated value or oil content of this tremendous natural reserve? It is treading on rather treacherous ground to make an estimate in this direction, but the precedent has already been set by geologists and engineers who have made careful surveys of the district. The United States Geological Survey is authority for the statement that the total area of oil-shale land in Colorado is approximately 896,000 acres; in Utah, 2,700,000 acres, and in Wyoming, 500,000 acres. Conservative estimates based on known depths of average workable shale indicate yields of 75,000 bbl.[1] per acre for Colorado; 15,000 bbl. for Utah, and 6,000 bbl. for Wyoming. These figures give the remarkable totals

[1]That this estimated yield is most conservative can easily be shown. Approximately 20 cu.ft. of shale yielding 40 to 60 gal. of oil will weigh 1 ton. An acre-foot (43,560 sq.ft. and 1 ft. in depth) would contain 2,178 tons of shale or roughly the same number of barrels (42 gal.) of oil. Assuming only 35 ft. of workable shale—and practically every tract of any economic importance will boast of twice this depth—we find that an acre would contain 76,230 bbl. of oil. Calculations based on comprehensive sampling and analysis on the property of the Naval Reserve on Parachute Creek indicated a yield of 185,000 bbl. per acre.

of 67,200,000,000 bbl. for the Colorado reserve; 40,500,000,000 bbl. for Utah, and 3,000,000,000 for Wyoming or in all, 110,700,000,000 bbl. It is easier to comprehend this gigantic quantity if we compare it with petroleum production. From the time the first well was drilled in 1859 to the end of August, 1924, this country has produced 7,666,772,000 bbl. In other words, our oil-shale resources in the three states of Colorado, Utah and Wyoming contain fourteen times as much oil as has been taken from the ground in the entire history of the American petroleum industry. Certainly these reserves are ample to supply any reasonable demand for at least a century.

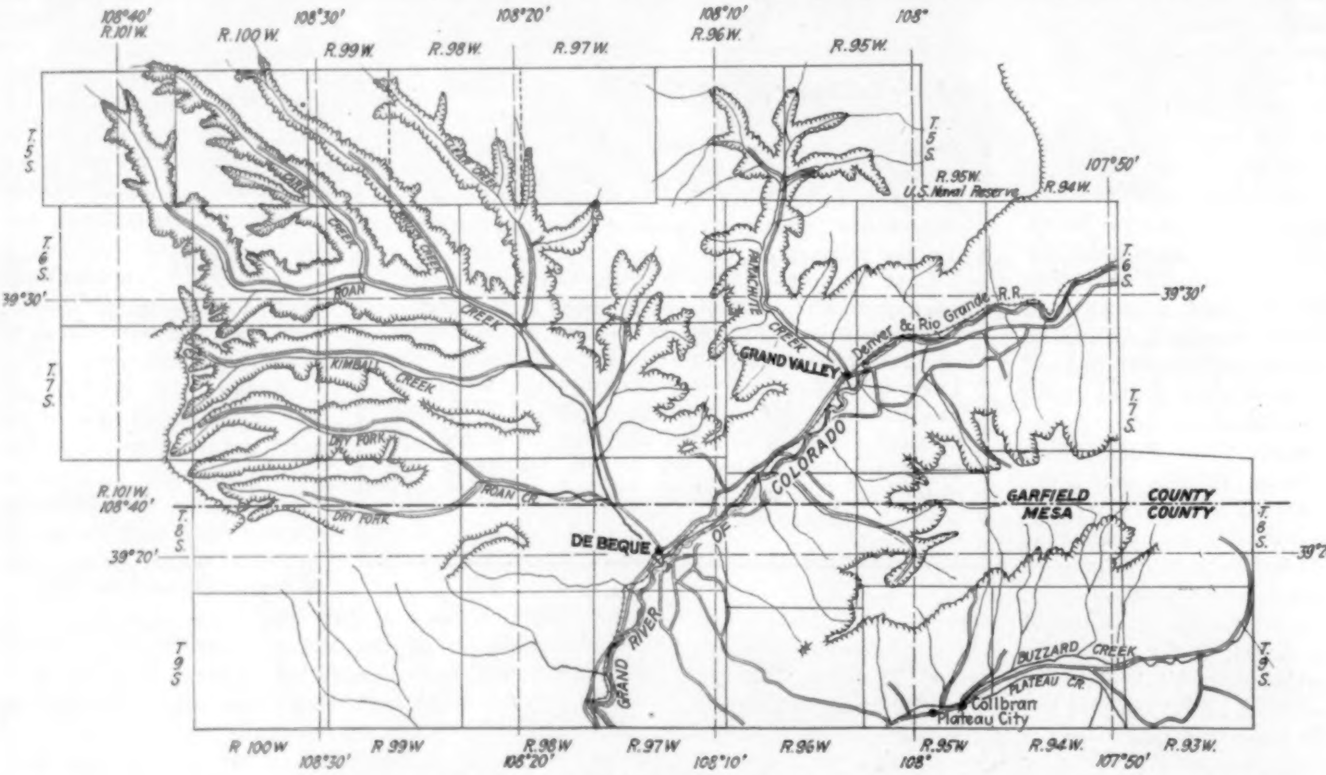
Five Periods in Oil-Shale History

In order to afford a better background for later discussion of economic and technical problems, it will perhaps be worth while to review briefly the history of oil-shale development. For reasons previously given, attention will be confined to the Green River shales of Colorado, Utah and Wyoming. In my own mind I have found it convenient to think of this development as being divided into five periods—each of which is characterized by a particular type of individual who could easily be called the outstanding figure in the period. Thus the first, 1908 to 1912, is that of the *Prospector;* the second, 1913 to 1915, belongs to the *Geologist;* the third, 1916 to 1918, was the period of the *Land Speculator;* the fourth, 1919 to 1922, was primarily the *Promoter's*, and the fifth, 1923, I would consign to the *Technologist*. Obviously, as always in arbitrary classification, there is overlapping of the different periods, but I believe that in general the scheme faithfully indicates recognizable stages in the development.

The question may fairly be asked: Why should 1908 be taken as a starting point in a history of American oil shale when it is known that before the Civil War more than fifty plants in Pennsylvania and other of the Eastern states were distilling "coal oil" from oil shale and other bituminous substances? Also it is a well-known fact that near Juab in Utah the early Mormon pioneers built and operated a crude retort for shale about the middle of the nineteenth century. All of these plants, however, are relics of the past. They were, figuratively speaking, wiped away by the flood of oil that followed Colonel Drake's drilling of the first oil well in 1859. It is more important that we confine our attention to the more recent developments affecting the shales of the Green River formation.

The Day of the Prospector

It was in 1908 that James Doyle,[2] returning from a prospecting trip along the White River, entered the Parachute Creek and Mount Logan districts of Colorado that have since come to be regarded as the centers of oil-shale activity. In 1909 Joseph Bellis, who had been prospecting in Montana, was shown a piece of rock that looked like *Lignum vitæ* and was told that it had been found at the head of Parachute Creek in Garfield County, Colorado. He was sufficiently interested to make a trip to the district and there located a 10-ft. vein of oil shale identical with the prospector's sample. At that time neither the United States Geological Survey at Washington nor the British Museum at London was able to classify the material satisfactorily except as "a high-grade hydrocarbon." Bellis, however, found that the material could be quarried (with some difficulty) and cut into slabs that took a beautiful dark wood-like finish. He called the material "petrified mahogany" and it was from this origin that the rich "mahogany vein" of oil shale got its name. A company was organized for exploiting the material for table tops



Oil-Shale Fields of DeBeque and Grand Valley, Colorado

This map, drawn by J. D. Freeman, of the American shale camp at DeBeque, shows the oil-shale outcrops or escarpments along the principal water courses of the district. Their accessibility to the Grand River and to the D., R. G. & W. R.R. is also evident.

[2]It is an interesting coincidence that the first patents on oil-shale land were issued to James Doyle and V. Z. Reed.

and interior decorating, but because of the difficulty in mining and handling slabs of usable size, the venture proved impractical. Work was also done at Mellon Institute in Pittsburgh, to find a method for molding the oil shale into insulators, battery boxes, etc., but progress in this direction ceased with the development of synthetic resins of the Bakelite type. About this time Dr. Otto Stallman, of Salt Lake City, retorted a quantity of Green River oil shale and fractionated the crude oil into products corresponding to petroleum distillates.

It would be a mistake to imply that Doyle and Bellis were the only pioneers of the "prospector period." There were literally scores of others who tramped the hills of the district and spread the knowledge of its minerals. One of these was Matt Callahan, of De Beque, from whom Mount Callahan received its name.

The Geologist Appears

Perhaps the first geologist to enter the shale fields was Prof. R. D. George, Colorado State Geologist, who in 1906 followed the southern outcrops of the shale beds from near Tucker, Utah, to Rifle, Colo., collected samples and made a series of tests of the shales as possible future sources of oil and of road-building materials. But what I have referred to as the period of the geologist actually dates from 1913. It was in that year that E. G. Woodruff and David T. Day, of the United States Geological Survey, came to Parachute Creek and made the investigation described in the first official report[3] of the resources. They were followed in February, 1914, by Dean E. Winchester, to whom must be given credit for a thorough reconnaissance of the district and the preparation of a comprehensive report[4] that had much to do with the arousal of public interest in the oil shales. At first this interest was largely local and had the effect of attracting many prospectors and a few capitalists to the district. Some of the latter brought with them their geologists and engineers, who contributed considerable in the process of opening up the district and actually ascertaining the extent and value of the reserve.

Dean Winchester was instrumental in bringing these deposits so forcibly to the attention of the government that the Navy Department—looking to its future oil supply—asked to have put aside for its use large reserves in Colorado and Utah. Naval Oil Shale Reserve No. 1, near Soldier Summit in Utah, embraces 86,584 acres, while Reserve No. 2, northeast of Grand Valley, Colo., amounts to 45,444 acres.

Practically all of the oil-shale resources were on land still in the hands of the government and there was some question at that time whether the old placer mining law applied to oil-shale lands. Nevertheless a great many claims were staked during the years 1915, 1916 and 1917 and later these received legal recognition under the terms of the leasing act of 1920.

Land Speculator Makes First Profits

The required annual assessment work to the value of $100 on each claim of 160 acres was not completed in some instances and the claims were allowed to lapse or were bought by other individuals. This accumulation of large holdings led to some competition and attracted many land speculators who had had no previous interest in oil shale. Their plan was merely to get control of locations favorable to transportation, water, dumping grounds, etc., and to hold them for future rise in value.

Toward the end of 1917 most of the government land easily accessible to the railroad had been located. The agitation in Congress for a federal leasing law for oil lands undoubtedly increased the interest in this territory, even if it did add to the uncertainty regarding the validity of locations made under the placer mining law. The passage of the leasing act of Feb. 25, 1920, quieted these fears, for the new law in addition to withdrawing all shale lands then unappropriated, recognized as valid all placer locations made prior to the date the law became effective. For each placer claim of 160 acres assessment work in the nature of labor and improvements to the extent of $100 a year for 5 years was

[3]Woodruff, E. G., and Day, D. T., "Oil Shale in Northwestern Colorado and Northeastern Utah," U. S. Geol. Survey Bull. 581 (1914).

[4]Winchester, D. E., "Oil Shale in Northwestern Colorado and Adjacent Areas," U. S. Geol. Survey Bull. 641 (1917); "Oil Shale of the Uintah Basin, Northeastern Utah, and Results of Dry Distillation of Miscellaneous Shale Samples," U. S. Geol. Survey Bull. 691 (1918); "Oil Shale of the Rocky Mountain Region," U. S. Geol. Survey Bull. 729 (1923).

A Typical Bed of Rich Oil Shale

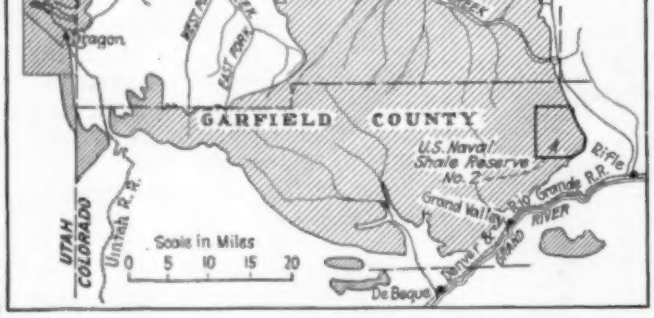
The papery and massive varieties of oil shale are well illustrated here. Note how the shale has weathered into thin, paper-like laminæ. It is bluish white in color but when fractured, as is seen directly below the hammer, the fresh surface is almost black in appearance.

required to get a patent for the land—that is to say, to effect a purchase from the government. Under the leasing act unappropriated lands could be leased from the government at an annual rental fee of 50 cents an acre plus a royalty on the products derived from the shale mined.

It was to the advantage of the land holder, therefore, to complete the assessment work and to get title to the land, since taxes and carrying charges are not exorbitant. It was apparent that the land would never be worth less than the cost of patenting and values were rising so rapidly in 1920 that there was no indication of what the peak would eventually be. Prices as high as $75 to $100 an acre were commonly talked about for land that a few years before had been held at $2 and $3 per acre. Obviously, the land that changed hands during these periods involved considerable profit for the original holders, and it can safely be said that to date the only considerable amount of money made out of oil shale—with the exception of that stolen by the unscrupulous promoter—went into the pockets of the land speculator.

Oil Companies Look to the Future

About this time two important factors appeared in the situation. One was the promoter with a little shale land, a process and some stock to sell. The other was the representative of the larger oil company. With Mid-Continent crude selling for $3.50 a bbl. and consumption far in excess of production, many of the progressive companies were looking out for their future oil supplies, and oil shale doubtless appeared attractive to them. Karl S. Schuyler, of Denver, and other officials connected with the Midwest Oil Co. were among the first to accumulate large personal holdings in Grand Valley and De Beque districts. Shortly thereafter the Union Oil Co. of California became the largest single holder with about 15,000 acres on Parachute Creek. This organization is reported to have invested practically a million dollars in purchasing claims and bringing the land to patent. The Ventura Consolidated Oilfields Co. of California has been granted patents on approximately 10,000 acres north of De Beque, Colo., and maintains on its property a permanent camp and supervisor. A number of other holdings in the De Beque district are generally referred to as the property of "interests identified with the Standard Oil Co.," the Indiana and New Jersey companies being referred to most often. Confirmation or denial of this allegation is wanting. At Green River, Wyo., several sections of land are held in the name of the Empire Gas & Fuel Co.



Northwestern Colorado and Northeastern Utah, Showing the Principal Areas of the Green River Formation

This map, adapted from one prepared by Dean E. Winchester for U. S. Geological Survey Bulletin 641, shows in outline the great oil-shale beds of this region, their transportation facilities and relation to rivers and streams

It is interesting to note that the general policy of the oil companies has been to get title to the land and to "sit tight." Apparently none of the large refining companies has gone deeply into the development of retorting methods—at least to the extent of erecting and operating larger-than-laboratory plants. The view is held that the refiners are willing to wait until there is a more pressing necessity for shale oil or until someone else develops and perfects the required process and equipment. There is a feeling that as long as all are on an equal basis in this development no special advantage will accrue to any single organization.

The Promoter and His Retort

Brief reference has already been made to the promoter, whose influence has had a marked effect on oil-shale development. The publication of the reports of the government geologists gave authenticity to statistics of resources that to the promoter must have seemed almost "too good to be true." Furthermore a wave of speculation was spreading over the entire country as a part of the aftermath of the war. The unscrupulous stock promoter and professional swindler were quick to take advantage of the opportunity to capitalize on the legitimate interest that had been aroused in oil-shale development. The claims of the stock prospectus with its glowing picture of easy wealth, its impressive figures and cost estimates seemed to find actual confirmation before the investor's eyes as the glib-tongued stock salesman actually demonstrated in a laboratory still how easily the oil was taken from the rocks.

Perhaps in all more than 250 companies were organized for the purpose of exploiting oil shale. These had their headquarters principally in the larger cities, Denver being a natural point of accumulation. It is a significant commentary on the high mortality rate among these ventures that of fifty or more with offices in Denver during 1920 less than half a dozen are still in existence.

The promoter had his "engineer" and the engineer had his process, with his "basic" patents on his retort. The special retort seemed to be a necessary accoutrement of every promotion, for the investor had to be shown that the company had perfected all of its plans even to controlling the only eduction method that promised to be successful on a commercial scale. The development of many of these processes ended in the drafting room, although a dozen or more demonstration units and larger-than-laboratory experimental plants were erected. A number of the latter are still standing in various parts of the country—almost forgotten relics of a promoter's dream, built, of course, with the stockholders' money.

There can be no doubt that these fakers and near-fakers did incalculable harm to oil shale. One of the results is to be found in the attitude of equipment manufacturers, many of whom advanced credit for these

questionable enterprises and built retorts and machinery for which they were never paid. Naturally many of these organizations have been unfavorable to oil-shale development, at least by small organizations without proper financial backing.

For most of these promotions the day of judgment was not long delayed. The general business depression of 1921 caused a tightening of public purse strings. Capital became wary of investments in new enterprises of any kind. Then as the final blow came southern California's flush production that completely turned the tables in the oil industry, bringing with it a period of overproduction and, later, a precipitous drop in oil prices. Under these circumstances much that was attractive about the oil-shale business disappeared and most of the unscrupulous promoters followed in the same path. A few of the more substantial companies—those with valuable land holdings or backed by sound technical advice—have survived the period of depression and are in a position to continue development when economic conditions permit.

Industry Turns to Technologist

It is patently unfair to confine the technologist to the most recent period in oil-shale history, yet there are many reasons why in the present situation he is and must continue to be the outstanding figure. The problems to be solved are primarily those for the technologist. The prospector and the geologist have proved the resources, pioneer developments since 1918 have done much toward clarifying and definitely establishing the economic basis for an oil-shale industry. It remains for the engineer to correlate the results of research and experiment and to build scientifically on the accumulated experience of those who have gone ahead.

To be sure, the chemist and the engineer have been at work on the problems of oil shale almost since the beginning of interest in the subject. The chemical and engineering departments of many of our larger universities, the government laboratories, particularly the Bureau of Mines and the United States Geological Survey, and the research laboratories of a few of the progressive oil companies have been most prominent in this work. They have accumulated much that is fundamental to our knowledge of the oil content of the different shales, of the composition and properties of the shale oil. Some progress has been made in the study of retorting methods, particularly of the effect of such factors as time, temperature and pressure. In the pioneer plants that have gone ahead with large-scale development such problems as the design of equipment, the selection of suitable materials of construction, the maintenance of operating control, have had to be solved empirically or on the basis of crude experimenting.

It is here that the technologist properly equipped with the requisite training and experience can be of most service. The pioneers have blazed a trail, but before an oil-shale industry can follow it, the technologist must clear away very serious obstacles to continuous large-scale and profitable operation. It is to the technologist that the industry must look for its future progress.

Editor's Note: Mr. Kirkpatrick's second article, discussing the economic problems in oil-shale development, will appear in a subsequent issue.

Industrial Electric Heating Proves Its Case

American Electrochemical Society's Recent Symposium Features Applications in Heat-Treating, Tempering and for Baking Auto Enamels

DETROIT'S industries are among the largest consumers of electric energy for heating purposes. It was natural, therefore, to find considerable local as well as national interest in the discussion of electric heating at the convention of the American Electrochemical Society, which was held in Detroit, Oct. 2 to 4. Other features of the meeting included symposiums on corrosion, refractories and superpower, all of which were reported in last week's issue of *Chem. & Met.* (pp. 583-8).

Advantages of Electric Heating

The Symposium on Industrial Electric Heating was in charge of Prof. C. F. Hirshfeld, of the Detroit Edison Co. The chief contribution was that of Prof. A. E. White, of the University of Michigan, on "The Use of Electric Furnaces in Heat-Treatment." Scientific heat-treatment is less than 28 years old. Recent years have witnessed a most rapid growth in the use of electricity for industrial heating. One large central station, for instance, that showed no industrial heating load in 1914, showed a yearly consumption of 30,000,000 kw.-hr. in 1918 and a load of 60,000,000 kw.-hr. in 1922 and expects a heating load of 110,000,000 in 1924. Professor White presented at length and in his typical exact scientific way the descriptions and operating records of the various types of heat-treating furnaces now in successful operation. The advantages of electric heating over other types are: (1) An even temperature. (2) Accurate automatic temperature control. (3) Freedom from gases, with elimination of excess scaling and pitting. (4) Heating by uniform radiation, rather than by cyclonic blasts of gases. (5) More comfortable working conditions. (6) More uniform product. (7) Lower re-treatment. (8) Lower scrap. (9) Ability to locate furnaces in closer relation to preceding or succeeding operations. One of the Detroit plants reported 18 per cent loss in scrap in oil-fired furnaces and 15 per cent in producer gas furnaces, as compared to no loss in electric furnaces. Electric forging furnaces cannot be operated successfully for any length of time above 1,800 deg. F. (982 deg. C.) due to the failure of the heating resistor. There is an urgent demand for a heating resistor that will successfully produce temperatures up to 3,000 deg. F. (1,649 deg. C.).

R. H. MacGillivray, industrial heating engineer of the Westinghouse company, reported upon a typical "Electric Furnace for Continuous Hardening and Tempering Wire" installed in the plant of a well-known shade roller spring manufacturer. This electric furnace consists essentially of two units. One is an electric-heated, air-hardening furnace, approximately 5.48 m. in length, the other an electric-heated, lead-drawing pan, the quenching being done in oil as heretofore. The hardening furnace has a nickel-chromium retort, with nickel-chromium resistance elements in top and bottom. This retort measures inside 33.02 cm. wide by 6.35 cm. high and 5.48 m. long—the full length of the furnace. Suitable insulation and refractory material

surround this retort, filling up the space between the retort and the outer shell of the furnace. The furnace is self-contained and is mounted on a stand, so that if necessary it can be readily moved to some other part of the plant. The lead-hardening pan rests in an insulated structure similar to the air furnace, but open at the top, with a ventilating hood to remove fumes.

The process is continuous. From 10 to 32 strands of wire, depending on the size, are run through the air furnace, quenched in oil and drawn through the lead pan.

The temperature control is automatic. Each 1.82 m. section of the hardening furnace has separate control, by means of electric pyrometers operating control panels connected on the primary side of automatic transformers. The temperature of the first and second sections is held at 982.2 deg. C. and the exit section at 898.8 deg. C. A recording chart on the pyrometers shows a temperature variation not greater than ± 1.5 deg. C. The lead pan is equipped with a single control of the same design, the temperature being maintained at 376.6 deg. C.

The connected load of the hardening furnace is 61 kw., and of the tempering pan 19 kw. Actual tests show an over-all operating consumption of 48.5 kw. for both units on continuous production. The heat-treating department is charged 2 cents per kw.-hr. for the furnace operation.

Table I—Comparative Costs of Electric- and Gas-Heated Furnaces for Hardening and Tempering Wire Springs

Cost per 100 Lb. (45.36 Kg.) Finished Wire

	Fuel	Labor and Fuel
Producer Gas Furnace	$0.381	$0.858
Electric Heated Furnace	0.26	0.53

A comparison of costs proves interesting, in that a saving of $0.328 per 100 lb. (45.36 kg.) of wire has been made by installing a modern electric furnace in place of the old gas-heated furnace. Further, the results are uniformly good, with practically no rejections of wire. Time, labor and material are saved, and the furnace in 6 months continuous operation has not required any repairs. In this period the gas furnace would have been shut down about nine times for repairs. The electric furnace occupies less floor space than the gas furnace and has twice the production.

Electric Annealing of Brass Tubing

"Annealing of Brass Tubing in the Electric Furnace" was described by Robert M. Keeney, also an electric heating expert of the Westinghouse company. Electric annealing of small brass tubing has proved to be more economical than annealing with wood fuel at the plant of the French Manufacturing Co., Waterbury, Conn. The brass is annealed in a 330-kw. electric furnace having inside muffle dimensions of length, 16 ft. (4.88 m.); width, 4 ft. 6 in. (1.37 m.), and height, 18 in. (45.7 cm.). The resistors, consisting of coils made of nickel-chromium alloy, are mounted in the walls, roof and floor. With power at 2.33 cents per kw.-hr. and wood at $8 per cord, the power cost per ton of brass annealed exceeds the fuel cost by only 7.5 per cent. Yellow brass tubing in small sizes, and thin gages can be annealed with a power consumption of 110 kw.-hr. per ton (2,000 lb.; 907.2 kg.) of tubing, or 18.2 lb. (8.05 kg.) per kw.-hr. Lower labor costs due to greater rate of production, less time required for pickling because of much less oxidation of the brass, and no handling of wood, result in lower total costs for electric annealing.

The above three papers were discussed at length not only by chemical and electrical engineers but by central station men and operators as well. G. MacGregor, of the Wolverine Tube Co., said that electric annealing of brass tubing saved the situation in his plant, as it has become almost impossible to obtain chestnut wood today. Wirt Scott, of the Westinghouse company, described a brass-annealing furnace located at Newark, N. J. A water seal is used at each end and the brass comes out bright. E. F. Collins, of the General Electric Co., referred to comparative tests of oil-fired versus electric annealing furnaces and reported that with the electric anneal the brass came out much softer. However, there is no doubt that for certain specific purposes oil furnaces might be preferable.

Melting Bronzes in the Detroit Electric Furnace

F. C. Heath, works manager of the Federal Mogul Corporation, has installed five Detroit Electric furnaces melting 230 lb. to the charge, equivalent to the capacity of a No. 70 crucible. Each furnace is equipped with a 100-kva. Kuhlman transformer and makes twenty-one heats per day, starting the arc at 6:15 a.m. and finishing the twenty-first heat at 3:15 p.m. At the rate of input of 90 to 100 kw. it is not economical to run the lining more than 1,000 heats. The copper-zinc-tin-lead composition of the bronzes melted runs: 88-10-2, 80-10-10, 85-5-5-5 and 85-5-9-1. The elastic limit of the electrically melted bronzes is about 6 per cent higher than that for bronzes melted in coke-fired furnaces. The melting cost is $3.50 less per ton in the electric furnace. The metal loss is about one-half of 1 per cent in the electric, as against 3 per cent in the coke-fired furnace.

Mr. Heath's paper was discussed by George K. Elliott, F. A. J. FitzGerald, Colin G. Fink, H. M. St. John, and John A. Seede. Mr. Elliott considered the furnace performance as reported by Mr. Heath exceptionally good.

Baking Enamels on Automobiles

The Dodge Motor Car plant operates a series of highly efficient electric enameling ovens. Henry Allen described the installation at length. The cost of electric enameling during the first 6 months of 1924 was equivalent to 484 kw.-hr., or about one-half of 1 per cent of the average selling price of the car. The number of cars produced during this period was 125,610. The proper ventilation of the ovens is an important factor. While it is claimed that from 2,000 to 2,250 cu.ft. of air per gallon is sufficient, in practice this amount is much too low. With too little ventilation the finish has a flaky or "buttermilk" appearance. The use of cellulose base materials, which require little or no heat, is making rapid progress.

Commenting on Mr. Allen's paper, a number of engineers called attention to the fact that explosions in the ovens no longer occurred, due to decided improvements in design and ventilation. L. A. Danse, metallurgist of the Cadillac Motor Car Co., brought up the question as to the advisability of preheating the air before entering the oven. E. F. Collins stated that in the enameling of shoe irons this method was found to be preferable. For core heating Wirt Scott said the hot air method was much cheaper.

The Commercial Recovery of

Fossil Gums

In This First Article Some Interesting Facts on the Occurrence and Mining of Amber Are Discussed

By W. M. Myers

Assistant Mineral Technologist, New Brunswick Station, Bureau of Mines

UNDER the term fossil gums, or fossil resins, are grouped all those resins originating at an unknown date but sufficiently remote that the original trees from which they were formed have fallen, disintegrated through processes of decay, and in many instances completely disappeared. These resins were probably all formed in very much the same manner as resin is produced today on a commercial scale, with the difference that the original flow was not excited by accurate incisions made by man, but by openings made in the bark by insects, birds, breakage caused by the wind and other natural forces. The resin that was exuded into these ruptures hardened on exposure to the air, and when the flow was continued the original surface was thrust out from the tree until large masses accumulated. These masses of resin were formed on the trunks and branches of the trees and also at times dripped off in such quantities as to build up large aggregates on the ground. The masses of resin formed on the trees often display remarkable purity, being entirely free from any foreign material. This is due to the manner in which they were formed.

What Fossil Resins Are

Fossil resins were produced by many varieties of trees, some of which are extinct today; the descendants of others are still in existence. After the fall and decay of the trees, the more stable resins were left on the surface of the ground, where they were subsequently covered by soil and organic detritus, which has buried them to the comparatively shallow depths at which they are now encountered. The length of time that these resins have been buried varies from the thousands of years that have passed since the Tertiary and Carboniferous periods to the single life span of a resin-producing tree, possibly a hundred years. These resins are inert chemically, and aside from a slight surface alteration display few indications of their long burial in the ground. The most marked physical change is an increased hardness and insolubility, both of which appear to increase with age.

Due to their age and manner of occurrence, and to distinguish them from the resins produced from living trees today, they are generally called fossil resins. Commercially they are more commonly known as fossil gums. The fossil gums of commerce are amber, kauri and copal. These terms are used very loosely and refer to gums from certain localities rather than to gums of definite and similar composition.

Geologically, amber is the oldest of the fossil resins, as it is believed to have been produced during the Tertiary period by a conifer, now extinct, known as *Pinites succinifer*. The resins formed from these trees during this period have become so hardened during the countless centuries they have been buried in the ground, where they have been subjected to varying temperatures and pressures, that the amber found today is the hardest and most insoluble of fossil gums. Amber also differs from other fossil gums in containing a small amount of sulphur and succinic acid in amounts varying from 2 to 8 per cent, from the presence of which the mineralogical term for amber, "succinite," has been derived.

Amber has been used for ornamental purposes since prehistoric times, crudely carved pieces having been found in burial mounds of the stone age. It became an article of considerable importance in the earliest commerce of the world, and it is believed that the amber relics were obtained by the Phœnicians and other early navigators and travelers from the coast of the Baltic Sea, from which to the present day has come the bulk of the world's supply.

While amber occurs in many localities, commercial production has been limited to a few, principally East Prussia, Sicily and Burma. Small amounts of amber have also been found along the coast of the Arctic Ocean in Siberia and also in Rumania, Denmark, Sweden, England, France, Santo Domingo, Mexico, Canada and the United States. It is doubtful if any of the so-called amber found outside of the Baltic district may be strictly classified as such, as careful examination generally shows that while similar, it lacks the succinic acid content of true amber.

The Amber of East Prussia

The Baltic coast of East Prussia is the only district in the world that produces amber in sufficiently great quantities to maintain a well-organized industry engaged in the collection and preparation of this material for the market. The existence of an established industry was first mentioned in the fourteenth century, when it is recorded that a guild of amber turners was engaged in making beads for rosaries. From the sixteenth to the eighteenth century an industry of large dimensions, centered at Königsberg, was engaged principally in the production of amber ornaments. Many of these ornaments, carved in delicate design and with great artistic ability, having survived time and accident, are now treasured in our museums.

The demands of the carvers were supplied by material collected on the coast where it had been thrown by the sea, and amber collection became an important though irregular industry. The harvests were particularly good after storms, when considerable amounts of material were thrown up on the beaches. The search was taken up in the sea itself, for on clear days amber fishers were able to work to shallow depths from boats. Spears were used to turn over rocks on the ocean bottom, and any amber liberated was captured in nets. Seaweed that often had pieces of amber entangled in it was collected and searched.

Systematic Mining Methods Adopted

Until the middle of the nineteenth century the supply of amber was dependent largely upon irregular methods of collection. The amber-bearing strata were known to exist at inland points at shallow depths, but these deposits were not worked systematically and the production was of little importance. After 1860 more systematic methods of collection were adopted and the whole amber industry made a great advance through the activities of the firm of Stantien & Becker, which instituted the use of divers and steam dredges to recover amber from the sea. These were abandoned later

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and the attention of the amber industry became centered upon systematic mining methods.

The most productive area was found to be a narrow strip of the coast line running from Palmnicken to Neukuhren. A geologic section of this district shows that the surface exposure is a stratum of sand and marl, below this is a layer of lignite associated with some sand and clay, beneath which is a stratum of greensand from 50 to 60 ft. thick. Amber is found in scattering amounts throughout all of these strata, but the most important concentration from which the commercial production is derived occurs in a layer 4 or 5 ft. thick at the base of the greensand. This layer is nearly black when first exposed and is commonly known as the "blue earth." To reach this productive layer it is necessary to make openings from 60 to 100 ft. or more in depth. Open-cut mining on a large scale was carried on for a time. Enormous tonnages of overburden had to be removed to expose small areas of the amber-bearing blue earth, which made the operation expensive.

As the openings were near the sea, there was also danger from flooding, so open-cut mining was abandoned and underground methods were employed. Shafts provided with modern hoisting and pumping equipment were sunk to the amber-bearing strata, and extensive underground workings developed. At the largest mine near Palmnicken the total length of underground workings has been reported to reach 2 miles. The ground is heavy and requires a large amount of timbering for support. Miners loosen the earth with pick and shovel and collect in bags any amber exposed in the operation, premiums being paid for particularly good finds. The blue earth is transported in horse-drawn cars, hoisted to the surface and dumped on a screen, where the earth is washed from the amber with a hose. The danger of collapse of these underground workings and the difficulties encountered from the presence of quicksand have caused the resumption of some open-cut mining where conditions for economical operation are favorable. The average yield from the workings is reported to be about 7 lb. of amber per cubic meter. The pieces of amber are small; one of the largest ever recovered weighed 18 lb.

Preparation of Amber for the Market

The surface of the amber found in the blue earth has undergone a partial disintegration, which has imparted to it a typical goose-skin texture. This exterior alteration is removed by scouring with sand and water in rotating barrels. The amber is then sorted and classified carefully according to quality, size and color.

Amber may be roughly classified into two groups. One includes the amber that is transparent, varying in color from yellow to dark brown; the other includes the amber that may be translucent or opaque due to the presence of a large number of minute bubbles. This variety is commonly known as bone amber. Amber is utilized for the manufacture of smokers' articles, ornaments and byproducts. It has long been a favorite article for cigarette holders and pipe stems, large quantities being used for these purposes annually. The commonest ornaments produced are beads, although it is also used in pendants and other forms of jewelry. Some very skilled carving has been done in amber, and its use as a decorative inlay in furniture, chests and candelabra has been particularly popular in Russia.

In carving amber, the blocks are first cut roughly with a saw and are worked either with chisel and file by hand or else turned on a lathe, depending on the type of work. The surface is smoothed with emery, and the final polish produced with chalk, soap and water. Most of the amber produced is worked up in Königsberg, Danzig and other smaller cities, only a small amount of the raw material being exported. The imports of crude amber and amberoid into the United States in 1923 amounted to 2,172 lb., valued at $24,773.

The fine chips that are produced in scraping and working the larger material are distilled in open kettles, which connect with condensers. When heated to 375 deg. C., amber fuses and gives off black fumes, which are drawn into the water-cooled condensation chamber. The amber oil is drawn off the top of a set of cylinders connected with this chamber, while the succinic acid collects at the bottom and is removed in white crystalline masses. A residue is left in the kettles; this is cast into molds and then broken up into pieces and used in the manufacture of varnish.

The smaller sizes of clear amber that are too valuable for distillation are carefully cleaned and are then fused into large masses known as "amberoid." This fusion is accomplished by heating the amber to about 200 deg. C., which softens it to a viscous liquid. This liquid is subjected to pressure and the fused amber, extruded through small openings in rods, coalesces and solidifies into a homogeneous mass. In this manner very large masses of amberoid have been prepared. Amberoid can scarcely be distinguished from natural amber and is used extensively for the same purposes. Close examination will generally disclose that it lacks the brilliancy and perfect homogeneity of true amber, as it is apt to display a typical undulating wave structure due to the incomplete mechanical mixture of resins possessing slightly different indices of refraction.

Various Kinds of Amber

A fossil resin similar to amber and commonly called such has been found in a number of localities and exploited to a slight extent. Sicilian amber has been collected on the eastern and southeastern coasts in small amounts for years. It has also been found inland at shallow depths in the soil and in the beds of streams whose waters have excavated it from the soil. It has been used as an ornamental material by the natives, and small amounts have been exported. It does not occur in sufficient amounts to maintain an established industry. Sicilian amber is unique in the remarkable color display which some specimens exhibit. This color display is caused by minute inclusions that produce a fluorescence varying from ruby red to a typical bluish green similar to that seen on a film of oil. Pieces showing a good fluorescence are highly valued and are very expensive for ornamental use.

A fossil resin is also mined and marketed under the name of amber in Burma. The mining is carried on in a very primitive manner by the natives and the Chinese. Shafts are sunk to a depth of 45 ft. to the amber-bearing strata and small workings excavated. The work is commonly carried on by three men, one of whom digs while the two others hoist the loosened earth in baskets. The annual production is small, seldom exceeding 2 tons, valued at approximately $3,000. This production is consumed almost entirely by the Chinese, who produce excellent amber carvings.

Using X-Rays to Detect Hidden Dangers in Plant Equipment

Defects in Castings Used in High-Pressure Stills, Overlooked in Inspection by the Usual Method, Are Easily Seen in the Radiograph

By H. H. Lester,* E. C. Herthel,† William Mendius‡ and William V. Ischie‡

IN PETROLEUM cracking the temperature used is around 750 deg. F., at which point the strength of steel is not at its best, a point of great importance when the steel is used as a part of a container under an internal pressure of somewhere around 100 lb. per sq.in. Any flaws in the steel parts of this container or any particular thinness will magnify the hazards of the operation. In appreciation of this, many of the refining companies have made a particular study of their steel on the cracking units, involving materials, design and surface inspection. The Sinclair Refining Co. has been carrying on intensely such an investigation and inspection since 1919. It lays much of its success in the prevention of fires to this.

The cracking still is composed of a shell of boiler construction that holds the bulk of the oil under treatment. The oil within this shell may be heated by application of furnace gases directly to the shell or by passing the oil from the shell through steel tubes arranged within a furnace remote from the shell. The steel tubes within the furnace, generally known as the heater, are connected to the shell by extra heavy piping and cast-steel fittings. Accessories to the shell, such as man-holes and vapor domes, are also cast in steel. The capacities of such stills may vary from 25 bbl. to as high as 1,000 bbl. of hot oil.

The weakest part of a cracking unit is in the heater or in the shell surface if it is heated directly. These surfaces become internally coated with pitches and carbon formed in the decomposition of the oil, and such coating acts as an insulator, causing the overheating and weakening of the steel wall, with possible failure and discharge of the entire contents into the firebox, sometimes with very disastrous results.

To prevent the possibility of such failures of the heating surface, the weakest part of the still, the Sinclair Refining Co. has made a thorough study of the heater tubes in its steel investigation. The tubes were studied, both before and after service, by physical tests and by chemical and metallographic analysis. The wear on the tubes, internal and external, was studied under varying conditions and with tubes of various gage. Transfer of heat from furnace gases to the tubes was studied. As a result of such research, the company's heater life has been extended 300 to 400 per cent. Although a few fires have occurred, due to tube failures at the start of the cracking process operations, the Sinclair Refining Co. has not experienced any such misfortune for some years past. The steel in the heater, its rate of wear and its probable life are now known very well. This does not, however, cover any possible hidden defects in the steel.

A similar study on the rolled steel in other parts of the still has been carried on, with improvements in design and increasing safety and length of life. The study, however, is not as yet as complete as that of the heater, and both researches are still in progress.

Such rolled or drawn steels are, due to their method of manufacture, more compact in texture than steel castings. Barring slag inclusions and faulty joints that may not have been detected during regular inspection, they can be considered as steels of uniformly good strength, and their life can be determined as a factor of their thickness.

Such is not the case with cast steel. Experienced users say that there are no perfect castings. Porosity and cracks from various causes may be inherent in varying degree, entirely undiscernible by an ordinary physical inspection, and in most cases where they may be discernible they have been welded so that the inspector is not aware of their presence. The Sinclair Refining Co. has been seeking for some time to find a means of making a thorough study of the steel castings used by it, and although there has been close factory inspection, difficulties in operation with castings continue to appear. Luckily, however, no failures have occurred.

An article by Dr. H. H. Lester in *Chem. & Met.*

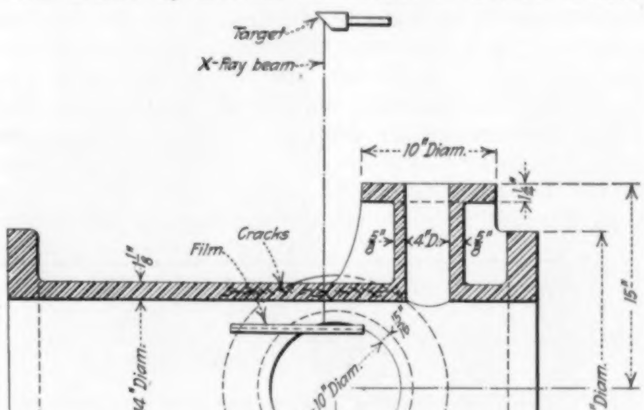


Fig. 1

The film is held in such a position that the X-ray beam strikes it after passing through the wall of the casting. If any defects are present, their shadows will appear on the developed film.

*Research physicist, Watertown Arsenal, Watertown, Mass.
†Assistant to vice-president, Sinclair Refining Co., Chicago, Ill.
‡Experimental engineers, Sinclair Refining Co., Chicago, Ill.

Feb. 15, 1923, entitled "X-Ray Inspection of Steel Castings," described results obtained by the X-ray examination of castings in the laboratories of the Watertown Arsenal, Watertown, Mass. Such a method showed promise of virtually looking through the casting, showing up such internal defects as inclusions, porosity and cracks.

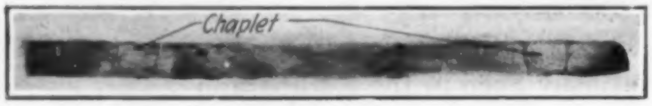


Fig. 2
Chaplets are metal supports placed in the mold to hold the core in position. This cross-section shows the presence of two chaplets of poor design. They are too thick and consequently they have not fused.

Some of the Sinclair company castings have since been examined by this method and the defects found were as dangerous as or more dangerous than many of the defects found in the ordinary way. The investigation was broadened and a definite study of casting defects was undertaken. This was done because study up to this point had seemed to indicate that the foundries were doing their best and that no amount of increased rigidity in inspection could insure sound castings. It seemed to the Sinclair company that it would serve itself, other casting-using industries and the foundries too by making a study of casting defects to the end that the defects might be removed by improved methods of manufacture rather than by increased rigidity of inspection. It is realized that by means of X-rays increased rigidity of inspection could be inflicted on the suffering foundries, but it would seem that a better and a more economical procedure would be to use the X-ray as a constructive tool as an aid to the manufacturer rather than as a destructive tool, as the foundries would view it, by putting it on acceptance inspection alone. This paper details the results of the investigation of casting defects as they occur in Sinclair Refining Co. castings. It also indicates some applications of the X-ray to ordinary foundry problems.

The tests were planned to reveal defects and to correlate them with probable causes. X-rays were relied upon to locate the defects and to give an idea of their nature. Fig. 1 illustrates the arrangement of the casting, the source of X-rays and the photographic film. In practice, the casting is marked off into areas through which radiographs are desired. Defects, such as cavities, cracks or inclusions, are indicated as dark spots on the X-ray negatives. To get more complete information, the castings were cut through some of the defects

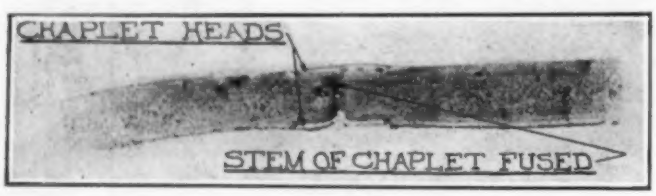
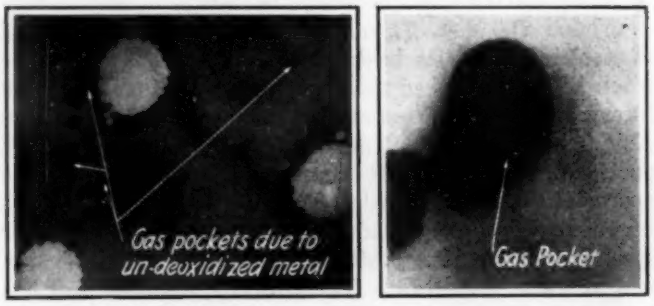
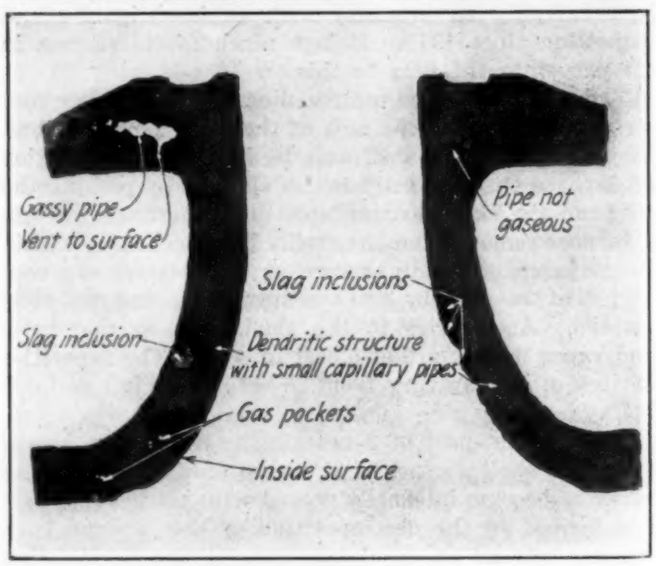


Fig. 3
Cross-section through a chaplet of good design. The stem of the chaplet was narrow and so it was easily melted when the casting was poured.

shown. In cutting, usually a double saw was used, and a $\frac{3}{16}$-in. cross-sectional piece taken out. This was surface ground and the defects revealed were examined carefully. Inclusions shown were picked out and analyzed. After this, the section was radiographed and later etched by boiling in a solution of hydrochloric and sulphuric acids. This treatment develops cracks, cavities, spongy areas and differences in metal texture. In many cases cracks too fine to be revealed by X-rays and by surface inspection are developed in this way. The number of X-ray pictures taken varied with the castings, the average number being seventeen. The pictures were of different sizes, 5x7, 8x10 and 14x17 in., depending on the size and contour of the portions to be radiographed. The average area covered in each picture was approximately 64 sq.in. The thickness of the sections radiographed varied from $\frac{1}{2}$ to 3 in. The castings varied in weight from 65 to 1,400 lb. In one casting of average size 63 per cent of the metal surface





Figs. 4 and 5 (Above) and Fig. 6 (Below)
Above—Radiographs showing the presence of gas pockets in the metal. The large gas pocket at the right was drilled into and found to have a volume of 18.2 c.c. Below—A cross-section of a nozzle taken from service. A radiograph would have shown these defects.

was actually covered by the radiographs. Probably the average metal radiographed was between 30 and 50 per cent of the total metal of the casting. Of course, vital sections were covered more closely than sections of less importance. This is the usual procedure in the X-ray laboratory, the number of pictures taken depending on the information desired.

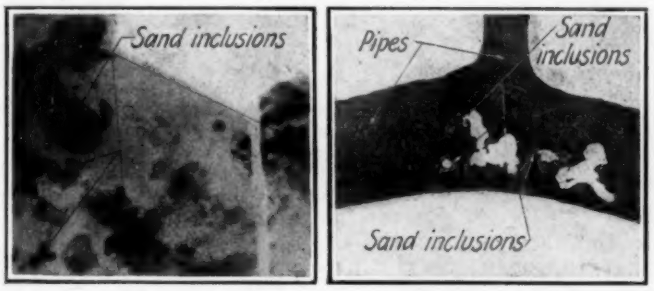
The results of the various tests in which the defects are classified according to their nature and correlated with probable causes are given below.

1. *Offset Cores*—Offset cores represent a defect found too frequently in castings. X-rays are not needed to show this condition. It is recorded here because of its frequent occurrence. The defect is serious, because the thin wall is much weaker than designed.

2. *Chaplets*—Fig. 2 shows a section through a poor

chaplet and Fig. 3 through a good one. Chaplets are metal supports placed in the mold to hold the core in position. The supporting stem is usually small and terminates in flat metal heads, which press against the walls of the mold and core. Sometimes, as in Fig. 2, a piece of relatively thick cold-rolled steel is used instead of a proper chaplet. In such cases the metal does not fuse. Usually a layer of oxide separates the chaplet from the rest of the metal. Even in a properly designed chaplet the metal seldom fuses completely. The center may and usually does fuse, but the heads and a portion of the stem may not. On account of the uncertainty of fusion, chaplets should be avoided where possible in pressure castings.

3. *Gas Pockets*—Gas is responsible for a majority of the cavities that occur in steel castings. These gas cavities arise from several sources. Figs. 4 and 5 show different types of gas cavities. Cavities are sometimes caused by loose sand carrying carbonaceous material



Figs. 7 and 8
A radiograph and a cross-section which show the same thing—sand inclusions in a carefully made casting that had been passed for service after a thorough inspection by the usual methods.

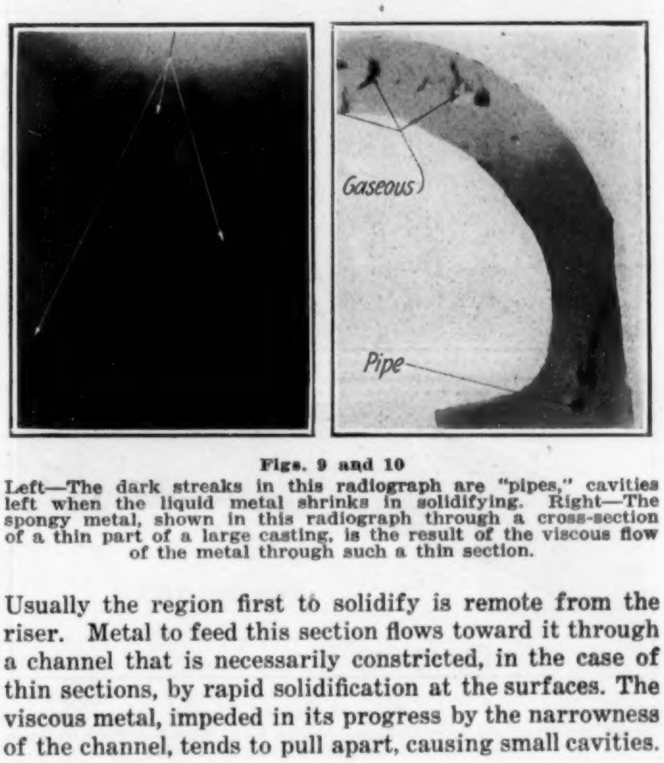
such as molasses binder contained in the sand. This sand becomes trapped in the metal and the carbonaceous material is broken down with the generation of CO. The cavities are usually bright on the inside except that they may contain some sand and a deposit of carbon. Fig. 4 shows cavities characteristic of undeoxidized metal. These cavities are also bright walled, but contain no sand. Sometimes they contain iron oxide. In this case carbon from the steel reacts with FeO, forming CO and Fe, which is deposited on the walls of the cavity, giving them a silvery white appearance. The condition may be remedied by proper deoxidization in the furnace or ladle. Fig. 5 illustrates a type of gas cavity frequently found. Here gas entered the casting due to pressure generated in the core. The gas might have been air, steam or decomposition products from combustible matter in the sand.

Fig. 6 illustrates another condition due to gas. Here gases that may have come from the reduction of FeO, or may have come from the outside, collected in pipes (the occurrence of "pipes" is explained hereafter) and in the central part of the section in the region of last solidification. This condition enlarges pipes and tends to increase greatly the porosity in the center of the metal section. Moreover, the cavities in the metal frequently have external vents to both the inside and outside surfaces, thus causing "weeps" in hydrostatic tests. The condition of the casting may be greatly improved by the elimination of gas; the pipes and spongy center may remain, but the pipes will be smaller and the sponginess less pronounced.

4. *Inclusions*—Figs. 7 and 8 illustrate sand inclusions. Slag inclusions, illustrated in Fig. 6, resemble sand in the X-ray negatives and it is often difficult to distinguish either from gas pockets. Most castings contain a greater or less amount of sand, although it is negligibly small in some cases. The possible seriousness of the defect is illustrated in Figs. 7 and 8. These pictures may represent an extreme case, but the casting from which they were taken had been carefully made, had been subjected to a thorough inspection and had been passed for service.

5. *Pipes*—Fig. 9 illustrates a type of defect to be expected in most castings. Liquid metal occupies more space than solid metal, and as freezing starts from the surface and proceeds inward, metal is drawn from the center to make up for the change in volume. After the liquid metal has been used up there still remains an unoccupied space. This cavity is called a pipe. Pipes are formed in the region of metal last to solidify. Usually they occur in the center of a thick section. Sometimes the presence of chills modifies this, so that the pipe may be displaced from its normal position. Pipes always tend to occur in the neutral axis of the section. Sometimes subsequent machining operations throw them out of the neutral axis. When this occurs, pipes are more dangerous. Where they occur in sections that necessarily carry excess metal, their presence is very often unimportant. Unfortunately they frequently occur in connection with gas pockets and serve to connect up pockets that have inner and outer vents. In such cases they are, of course, sources of danger. They are dangerous in any place where the cavity is large relative to the wall thickness.

6. *Spongy Metal*—Liquid steel is rather viscous and becomes more so as it approaches final solidification. Due to this fact the flow into any given section to take up shrinkage is imperfect. In consequence there is a tendency for fine capillary cavities to occur in the portion of the metal last to solidify. This causes a spongy texture in the metal at the center of the section.



Figs. 9 and 10
Left—The dark streaks in this radiograph are "pipes," cavities left when the liquid metal shrinks in solidifying. Right—The spongy metal, shown in this radiograph through a cross-section of a thin part of a large casting, is the result of the viscous flow of the metal through such a thin section.

Usually the region first to solidify is remote from the riser. Metal to feed this section flows toward it through a channel that is necessarily constricted, in the case of thin sections, by rapid solidification at the surfaces. The viscous metal, impeded in its progress by the narrowness of the channel, tends to pull apart, causing small cavities.

These cavities appear frequently in radiographs taken perpendicular to the surface as irregular lines that suggest cracks. They appear more definitely in the radiographs of the cross-sections as illustrated in Fig. 10. These cavities are developed by macro-etching as illustrated in Fig. 6. Where, as frequently happens, gas gets into this spongy metal, these cavities are enlarged and the porosity considerably increased. Such a case is illustrated in Fig. 12. This illustration also brings out the fact that there is always a skin of good metal at the surface. Gas vents sometimes connect the internal spongy material with the inner and outer surfaces, giving rise to weeps during hydrostatic tests. In castings subject to erosion and corrosion the spongy interior metal wears rapidly after the tough surface skin is worn through, thus materially reducing the life of the casting.

7. *Cracks*—Fig. 11 illustrates shrink cracks. These are cracks that occur in the metal after solidification. On account of the fact that castings often have sharp corners and angles, and thick and thin sections, stresses are set up in the metal due to unequal rates of cooling in adjacent sections. These stresses may exceed the tensile strength of the metal and cracks are formed. Cracks may be formed also by hard cores that do not crush and by hard rammed molds that set up stresses on flanges or other protruding members. Cracks of the latter type are found frequently in fillets, though fillet cracks may be caused by unequal rates of cooling. When cracks appear on the surface, they are usually welded. Unfortunately they do not always appear on the surface or else they appear on an inner surface where they are not visible to the inspector. Shrink cracks caused by

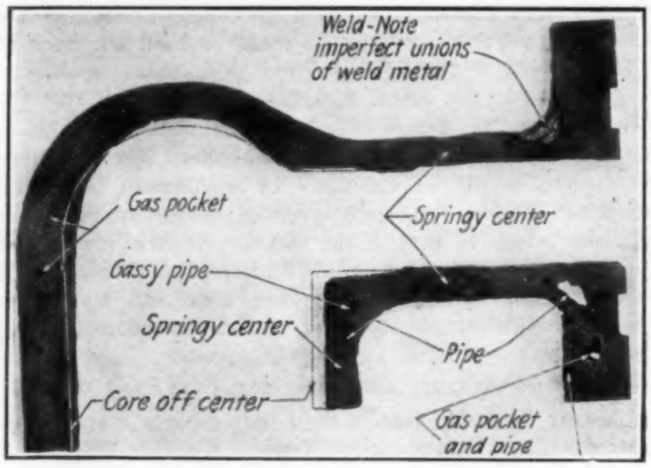


Fig. 13
Photograph of a "cross-section slice" taken from a side outlet ell which from the usual methods of inspection was considered a good casting.

unequal rates of cooling result often in a system of branching cracks as shown in Fig. 11. Of this system only the main crack is apt to appear at the surface. This main cracks would normally be welded, but this does not remedy the defect, because there is still a network of subsurface cracks. There is no certain remedy for cracks; they must be prevented. Due to the fact that such cracks are often caused by the sharp junction of thick and thin sections, in many cases it will be found difficult, if not impossible, to prevent cracks without changing the design of the casting. In most cases, however, the difficulty is overcome by the use of bonding brackets or chills. Where the cracks are caused by hard molds or cores, of course the remedy is obvious.

8. *Welds*—The present section should not be closed without reference to another weakness that has been found in a great many castings. This is poor welding. Cracks should not be welded, they should be prevented. They do occur, however, and are at least partly welded. If the welding is properly done, the defect is remedied as far as the visible part of the crack is concerned. Unfortunately the welding, in a large proportion of the cases, is not properly done. In some cases the crack is not completely chipped out before welding. An example of this is shown in Fig. 12. Sometimes, as shown in Fig. 13, the weld metal does not unite perfectly with the casting metal. In one case a section taken through the weld fell apart at the weld during handling.

Conclusions

When steel equipment is to be used in a service where the described characteristic defects of steel castings are considered hazardous, the situation may be met by one of three possible courses:

1. Forgings may be substituted for castings.
2. Steel castings may be used and X-ray inspection added to the present accepted methods of inspection.
3. Steel castings may be used that have had the characteristic defects eliminated by manufacture in accordance with a carefully developed casting technique. From the investigation covered in this paper, it appears that the casting technique can be readily developed with the aid of X-rays.

Figs. 11 and 12
These pictures show shrinkage cracks that would not have been detected had not the X-ray been used.

How Much Does Screen Testing Mean?

Fine Powders Cannot Be Tested by Screening Methods, Because of the Many Variables—Mesh Specifications Are Also Shown to Be Inaccurate and Meaningless When Above Certain Limits

By Raymond B. Ladoo
General Manager, Southern Minerals Corporation, New York City

MANY substances, particularly minerals and mineral products, are used in industry in the form of fine-grained, natural or artificially produced powders. Common examples are the mineral fillers, such as clay, whiting, silica, tripoli, talc, barytes, etc., used by the paint, rubber, paper, textile, phonograph record and other industries. In these industries there has been, in recent years, a growing tendency toward the use of finer and finer powders. Keeping pace with this tendency there has been an increasing interest in the framing, by consumers, of specifications based on fineness, and among producers, in the production of finer materials. Where a few years ago consumers demanded a "200 mesh" material, today they demand "325 mesh" or "350 mesh." We even hear in the trade much talk of "450 mesh" and "600 mesh," whatever these terms may mean.

Two Main Problems

These tendencies, just noted, have given rise to two main problems, each with many minor problems. These are, "How shall these materials be produced with the desired fineness of grain, uniformity and texture?" and "How shall the fineness and uniformity of the products be tested?" Only the second of these problems will be discussed here.

The most obvious and most common quantitative method of testing the fineness of powders is by the use of testing sieves or screens. Most producers and consumers of mineral fillers, if they test their material at all, express or attempt to express the fineness of grain in terms of screen mesh.

Before proceeding further we should consider just what is meant by sieve mesh. Standard testing sieves may now be obtained with openings from as coarse as an inch or more down to about 240 mesh—that is, 240 openings to the linear inch. Screens finer than this, down to 325 or 350 mesh, are made, but they are so delicate and so lacking in uniformity of opening size that they are not ordinarily considered standard. Due to the work of the U. S. Bureau of Standards and of some of the largest manufacturers of testing sieves, standard sieve openings and sizes of wire for each mesh have been adopted, so that in the United States today screen tests made on sieves of the standard meshes are always nearly comparable.

While 325- and 350-mesh sieves are made and used, they are not uniform in size of opening and it is impossible to obtain great accuracy in results. There are no sieves made in the United States or abroad, so far as the author has been able to learn, finer than 350 mesh, and this sieve has an opening approximately equal to that of the 325-mesh sieve. This point should be very strongly emphasized, for, as noted above, we often hear in the trade of "450 mesh," "600 mesh" and even "1,000 mesh." These terms are wholly misleading, for we have no basis, either practical or theoretical, on which to calculate how fine these sieves would be if they could be made or how to devise means for testing materials of these mythical meshes.

It may be argued that it is possible to calculate theoretically what the size of opening would be for, say, a 600-mesh sieve. But just how could this be done? The size of the opening in a sieve is fixed by two variables, one of which is the diameter of the sieve wire and the other is the number of openings to the inch. When we fix upon 600 meshes to the inch, what wire diameter shall we assume? Shall we assume that the wire diameter equals that of the 325-mesh sieve, or smaller, or larger, or equal to the sieve opening? If we assume that the wire diameter of the 600-mesh sieve is the same as that of the 325-mesh sieve (0.036 mm.), the opening in the 600-mesh sieve would be 0.0063 mm. But if we assume that the opening equals the size of the wire, the 600-mesh sieve would have an opening of 0.021 mm., a result more than three times as large as that obtained by the other method.

Furthermore, if we can estimate theoretically what a 600-mesh sieve would be, if there were such a thing, we ought also to be able to calculate to what theoretical screen mesh a grain size of given fineness would correspond. Thus, of what screen mesh could a grain of 0.002 mm. diameter be called? If we assume that the size of wire equals the size of the opening, it would be about 6,350 mesh, but if the size of wire equals that of a 325-mesh sieve, it would be only 670 mesh.

It should, therefore, be clearly apparent how absurd and misleading it is to talk about 450- and 600-mesh materials, until science and invention find methods to make sieves of these meshes.

What Does Mesh Size Mean?

Another question that should be discussed is what we mean when we say we are producing or buying or selling a 200-mesh material or a 325-mesh material. Most people vaguely mean by a 200-mesh material one a large part of which will pass through a 200-mesh sieve. But how large a part? Do they mean 100, 99.5, 95, 90, 80 or 60 per cent? If, say, 95 per cent through 200 mesh is wanted, how coarse can the remaining 5 per cent be? Can it be coarser than 100 mesh or as coarse as $\frac{1}{16}$ in., or must it be 100 per cent through 150 mesh? And, again, of the 95 per cent that must pass through 200 mesh, should 90 per cent of it also pass through 325 mesh, or only 50 per cent, or should it all be retained on 325 mesh?

The writer has before him the results of many screen tests made on different finely ground materials sold by different producers. Producer A sells a "200-mesh" material of which only 59 per cent will pass through 200 mesh and 96 per cent through 100 mesh. Producer B sells a "140-mesh" material of which 88.62 per cent will pass through 200 mesh and more than 99.5 per cent through 100 mesh. Producer C sells a "500-mesh" material, 99.13 per cent of which passes through 325 mesh, and a "350-mesh" material 99.25 per cent of which passes through 325 mesh. Thus his "350-mesh"

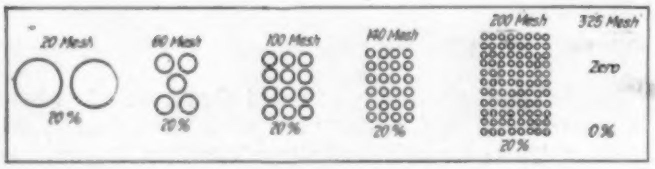


Fig. 1—Material *A*

material, by screen test at least, is slightly better than his "500-mesh" material. Producer D sells a "450-mesh" material which shows a residue of 1.75 per cent on 100 mesh and only 97.52 per cent passes through 325 mesh. Producer E sells a material which he guarantees as 99.5 per cent through 325 mesh and which actually tests 99.8 per cent through 325 and 100 per cent through 200 mesh.

Enough examples have been given to show that no two producers mean the same thing when they say they are selling "200-mesh" or "325-mesh" or "450-mesh" materials. The mesh grade names mean nothing unless further information is given to define more exactly the average fineness and range in grain diameters.

Screen testing gives very satisfactory results on coarse or medium fine material—that is, for example, material of which 80 per cent or more is retained on a 200-mesh sieve. But when dealing with such materials as clay or whiting or finely pulverized silica, of which 80 per cent or more will pass through 325 mesh, the problem is vastly different. In such materials the relative amount and nature of the so-called "impalpable powder" is of great importance.

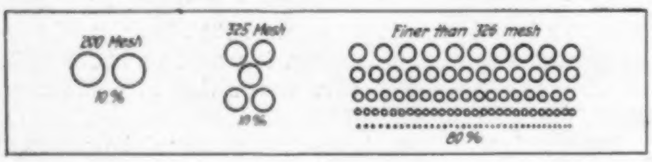


Fig. 2—Material *B*

Weigel,[1] who has given this subject much study, states: "Ordinary screen analysis is of little value except in determining the small proportion of coarse grains in some fillers; it gives no idea of the true average size of grains. The finest screens procurable have 300 and 350 meshes to the inch, with a nominal opening equal to 40 to 50 microns (1 micron equals 0.001 mm.), and all high-grade fillers, except a few special coarse ones, have an average grain size less than 15 microns. Moreover, satisfactory screens of the finer meshes are difficult to procure; even with careful selection of the wire cloth the size of the individual openings will vary as much as 30 to 40 per cent."

To illustrate some of the problems in screen testing graphically a few sketches have been prepared.

[1]Weigel, W. M., "Size and Character of Grains of Non-Metallic Mineral Fillers," Tech. Paper 296, U. S. Bur. Mines, 1924, p. 2.

In Fig. 1 is represented, greatly magnified and not to scale, a ground material, called *A*, in which the grains are of such size that 20 per cent will just pass through a 20-mesh sieve, another 20 per cent just through a 60-mesh sieve, and so on down to 20 per cent just through 200 mesh. A screen test of this material would be as follows:

Mesh	Per Cent On	Total Per Cent Through
On 20	0	100
Through 20 on 60	20	80
Through 60 on 100	20	60
Through 100 on 140	20	40
Through 140 on 200	20	20
Through 200 on 325	20	0

It is evident that the fineness of material *A* can be adequately expressed by sieve tests.

In Fig. 2 we have a material, *B*, 10 per cent of which will just pass through 200 mesh, another 10 per cent just through 325 mesh, and the remaining 80 per cent uniformly distributed through the various sizes from 325 mesh down to zero. In Fig. 3 we have a material, *C*, exactly like that in Fig. 2 so far as the 200- and 325-mesh material is concerned, but the remaining 80 per cent consists almost wholly of extremely minute

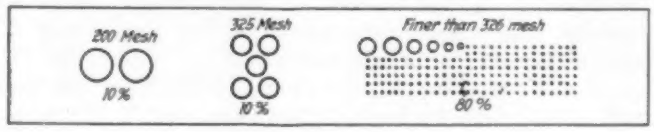


Fig. 3—Material *C*

particles, infinitely finer than the bulk of the 80 per cent in Fig. 2. The screen tests of these two materials would be identical, as follows:

Mesh	Per Cent On	Total Per Cent Through
On 200	0	100
Through 200 on 325	10	90
Through 325 on 326	10	80

It is apparent that by screen testing alone materials *B* and *C* could not be distinguished from each other. It is also evident that the screen tests are of no value in determining the grain size of the bulk of these two materials, but show only the fineness and quantity of the small percentage of the relatively coarse material.

Often consumers of finely ground materials will state that their specifications call for a minimum of 98 per cent through 325 mesh and that any material showing over 2 per cent residue on this screen will be rejected. They do not question whether or not this 2 per cent residue will pass through even a 100-mesh screen, nor, what is much more important, just how fine the 98 per cent is which passes through 325 mesh. This 98 per cent might be so coarse that it would just barely pass through the 325-mesh sieve, or it might range in size uniformly from 325 mesh (0.044 mm.) down nearly to zero, or it might be nearly all of extreme fineness, say 0.002 mm. in diameter. Two materials of vastly different nature and of greatly differing value to the consumer might both pass exactly the same sieve test specification. Or one material which might fail by one-half of 1 per cent to pass the 98 per cent 325-mesh specification, might be much better, in respect to uniformity, freedom from coarse oversize, in average grain size and in large percentage of very fine material, than another material which successfully passed the specification.

An example of this may be noted. A material, which we may call *X*, now marketed as "450 mesh," comes into competition with another material, which we may call *Y*, which is marketed only as guaranteed 97 per cent through 325 mesh. *X* is made by grinding a hard, massive material. It varies considerably in fineness, but usually runs from 98 to 98.5 per cent through 100 mesh and from 96 to 97.5 per cent through 325 mesh, although sometimes it runs as high as 99 per cent through 325 mesh. A microscopic examination of the 325-mesh product shows that the grain diameter ranges, more or less uniformly, from about 0.044 mm. (325 mesh) down to 0.001 mm., but with only a relatively small amount of very fine material (0.015 mm. and finer). *Y* is a soft, naturally disintegrated material, resembling clay, and very little grinding is needed to prepare it for market. While it is guaranteed as 97 per cent through 325 mesh, it usually runs more than 99 per cent through 325 mesh, and is 100 per cent through 200 mesh. As would be expected, a microscopic examination shows that it contains a very large proportion of very fine grains, averaging around 0.002 mm. in diameter. It is clear that *Y* is much finer than *X*, both in respect to retention on 325 mesh and in average grain size. Yet some users believe that *X* is finer than *Y* because *X* is called "450 mesh."

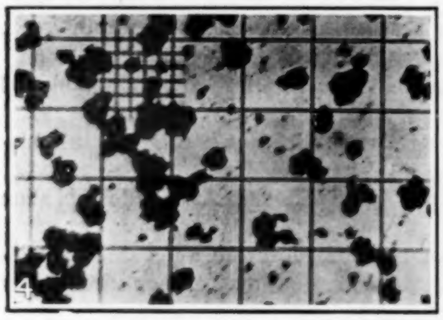
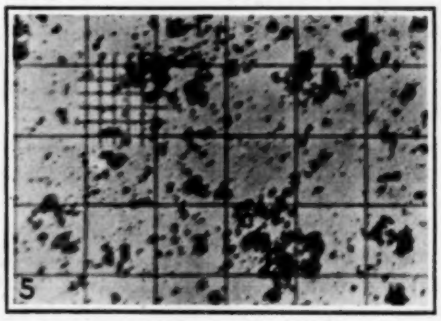
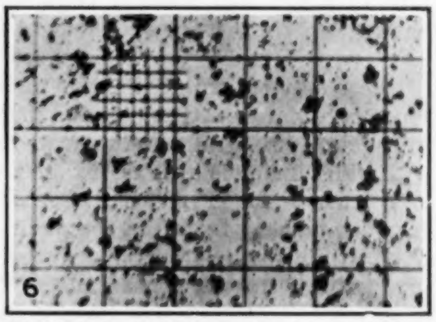




Fig. 4—Missouri Tripoli, Coarse Grade. Fig. 5—Missouri Tripoli, Fine Grade. Fig. 6—Illinois Tripoli, Fine Grade. All × 250.

How, then, should the true fineness be measured or estimated? Many methods have been suggested, but none of them are really exact and few are simple or rapid. Such crude qualitative tests as rubbing between the fingers or gritting between the thumb nails or between the teeth may give a rough idea of fineness, or rather of the presence of coarse grit, when dealing with soft materials such as talc or clay, but they are of little value when dealing with a hard or extremely fine material.

Air classification[2] has been used successfully for sizing portland cement, but it is doubtful if it could be used successfully on extremely fine materials. Water classification, using rising currents of water with different velocities, is fairly successful, provided the average grain sizes of the various water-elutriated fractions are later determined by microscopic methods.[3] Water classification methods, however, are slow and require considerable skill. A number of very good microscopic methods have been used,[4] but all of these, to obtain anything like approximate accuracy, requires considerable time, a high degree of skill, and often elaborate equipment.

There are two fairly simple ways by which a consumer can easily obtain some idea of the real fineness of his materials, although neither give quantitative results. By the use of a high-power microscope, (capable of magnifying 500 times or more), even an inexperienced observer can rapidly examine typical samples of his materials and determine the relative amounts of coarse, medium and fine particles. By the use of an eyepiece micrometer, calibrated by means of a stage micrometer, he can also estimate the diameters of the particles of the various sizes. Microscopes adapted to this type of work can now be obtained fairly cheaply and but little experience is needed to learn how to make these simple qualitative tests.

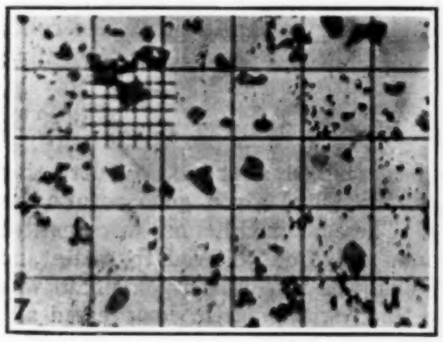
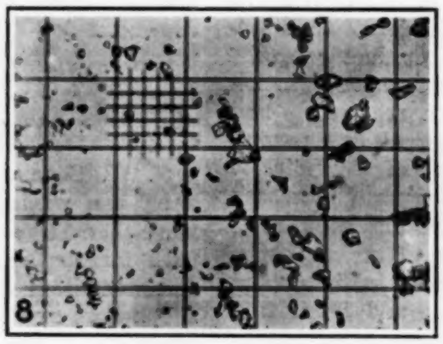
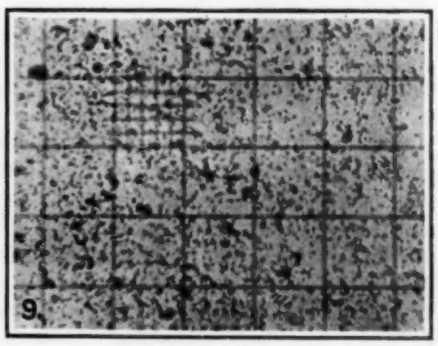




Fig. 7—Ground Quartz, Fine Grade. Fig. 8—Ground Sand, Fine Grade. Fig. 9—Tennessee Tripoli, Medium Grade. All × 250.

A second and even simpler method is to have a commercial photomicrographer make one or more photomicrographs of typical fields of each material, using a calibrated net micrometer in the eyepiece, by means of which grain diameters may be estimated in the finished photographs. If several photographs of each material are taken and care is used in selecting typical fields for photographing, the finished prints will give an excellent idea of fineness and uniformity. Of course the same magnifications should be used in camparing competitive

[2]Pearson, J. C., and Sligh, W. H., "An Air Analyzer for Determining the Fineness of Cement," Bur. of Standards, Technol. Paper 48, 1915, 74 pp.

[3]See Weigel, W. M., work cited, pp. 2-18.

[4]See Weigel, W. M., work cited. Also see Green, H. A., "A Photomicrographic Method for the Determining of Particle Size of Paint and Rubber Pigments," *J. Frank. Inst.*, vol. 192, November, 1921, p. 637.

materials. This method not only allows a layman to estimate the true fineness and general nature of his materials, but also it furnishes a permanent record for future reference.

The photomicrographs shown in Figs. 4 to 9 illustrate the great differences in fineness and general appearance of several finely ground mineral fillers. In all cases the magnification is 250 times; the large squares measure 0.040 mm. on a side (nearly the same as the opening in a 325-mesh sieve), and the small squares 0.008 mm. on a side. In each case the photomicrograph is taken only of that portion of the filler which will pass through 325 mesh. Thus only the "fines" are shown and the nature and amount of the coarse oversize (on 325 mesh) are not indicated.

These photomicrographs also bring out another interesting feature—that is, the much smaller average grain size of naturally disintegrated materials compared with filler materials made by grinding compact, massive crude rock. Fig. 9 represents a type of silica or tripoli resulting from the complete disintegration of a chert, while all the other fillers were produced by grinding compact, massive materials of varying degrees of hardness. This fact has been noted by Weigel,[6] who states that "when the fineness of grain of minerals is due to natural disintegration or weathering of rocks (clay, ocher and the silicas being considered), the percentage of surface rises very rapidly in the finer sizes, always showing a maximum for the finest grains considered . . . whereas the fillers produced by mechanical reduction or grinding show a drop in the surface curves in the finer sizes." Since specific surface (surface exposed per gram of material) is inversely proportional to the average diameter of the grains, it follows that the higher percentage of surface found by Weigel in the naturally disintegrated materials means much finer average grain size. For most filler uses a high specific surface is of great importance.

From all the evidence available it is clear that screen tests alone are of no value in determining the true fineness of a finely pulverized material. Screen tests are of value for examining materials of a granular nature, the greater portions of which are coarser than 200 mesh, and for setting an absolute maximum grain size for a very finely pulverized material.

Screen test specifications for fine materials should state:

1. Screen through which 100 per cent of the material must pass.
2. Maximum per cent of retention allowable on 200-mesh sieve.
3. Maximum per cent of retention allowable on 325-mesh sieve, (with tolerance to allow for non-uniformity of sieve).

Specifications should also provide either for microscopic examination by the purchaser or for the furnishing by the producer of typical photomicrographs made by disinterested parties, or for both. The marketing of very finely pulverized material on the basis of screen tests alone is not fair to purchaser or to producer.

[6]Weigel, W. M., work cited, p. 37.

Chemical Engineering Problems in Waste Disposal

CHEMICAL engineers are beginning to appreciate the fact that industrial wastes present obligations as well as opportunities. The old tendency to disregard these wastes unless a valuable product could be recovered from them is giving way to a recognition of the fact that waste treatment is a reasonable and necessary charge against many chemical engineering processes and operations. This change of viewpoint is the result both of economic conditions and of increased authority of those responsible for maintaining pure water supplies and for the prevention of stream pollution. In appreciation of this interest in industrial wastes the Division of Water, Sewage and Sanitation of the American Chemical Society gave attention to the subject in a number of papers at the recent Ithaca meeting.

Pea Cannery and Beet-Sugar Wastes

In discussing pea cannery wastes A. M. Buswell and R. A. Shive presented a flow sheet of the process which included the character and amount of the waste liquors discharged at various steps in the process. These wastes have an exceedingly high oxygen demand, being sometimes as much as 150 times as strong as ordinary domestic sewage.

Beet-sugar wastes were classified by Edward Bartow as beet wash, battery water, lime wash and Steffen wastes. In a treating plant installed by him the beet wash water was first screened and then, with the other liquors, passed through a series of ponds where a total of 22 days sedimentation was provided. Spillways between the ponds provided aëration. The fact that the beet wastes were produced for only a short time each year made the expense of settling tanks and sand filters unwarrantable. The Steffen waste contains valuable fertilizer, and some progress is being made in drying it for sale. In discussion R. H. McKee called attention to beet wastes as a source of methylamine, but stated that the market was small.

Dairy Can Washings as Fertilizer

G. W. Cavanaugh described a process for treating dairy can washings which had given good results for more than 11 years. The combined liquors were treated with ferrous sulphate and lime, allowed to settle and decanted from the sludge. The ferrous sulphate was added first and the tank agitated with compressed air, after which the lime was added. This sequence was necessary for successful operation. The effluent was stable. The wet sludge when spread on land at about the rate of ½ ton dry solids per acre doubled the yield of hay.

F. H. Jennings cited the difficulties encountered in preparing a good drinking water from a stream polluted by sulphite pulp liquors. Pretreatment with chlorine was unsuccessful due to the strong tastes and odors produced by the action of chlorine on the sludge in the sedimentation basins. Chlorination after filtration worked better. Because of advantageous local conditions it was possible to build a very large reservoir with a 10-day settling period; this, together with an aërating fountain, solved the difficulty. The large sedimentation further relieved the load on the filters so that the saving in wash water amounted to a million gallons per day.

Deodorizing Salmon Oil

Heating in Stream of Inert Gas Improves Quality of This Byproduct of the Pacific Coast Salmon Industry

By H. K. Benson

Professor of Chemical Engineering, University of Washington

NUMEROUS attempts have been made to improve the quality of the fish oils obtained as byproduct in the salmon industry of the Pacific coast. These oils have been subjected to hydrogenation, steam distillation, distillation in vacuo and various forms of heat-treatment. The present study, undertaken by a number of chemical engineering students under the author's direction, was confined to the effect of an inert gas on salmon oil heated to various temperatures.

This method has been the basis of a number of patents. In U. S. Patent 1,260,072, permanent deodorization is claimed to be obtained by heating the oil while bubbling hydrogen gas through it. In the method described in Norwegian Patent 34,401 (1922), a small amount of catalyzer is added to the oil, after which it is heated in a closed vessel with hydrogen and cooled in a hydrogen atmosphere. In British Patent 196,623 (1923), the oil is heated in vacuo in the presence of an inert gas below the carbonizing temperature.

In order to obtain comparable results, 100-gram samples of salmon oil obtained from local sources were used and the treatments continued for a period of 3 hours. The oil was maintained at the given temperatures for this period by two means: (*a*) up to 275 deg. C. with an oil bath and (*b*) above that temperature in an asbestos air bath, keeping the flask well protected from stray air currents. A 250-c.c. distilling flask was used, with an air condenser of hard glass, with ground glass connections both at receiving and delivery ends. At the delivery end was attached a train of three absorption tubes filled with chloroform to collect the products of distillation. The gases were measured by a venturimeter.

The results obtained by the use of three gases, hydrogen, nitrogen and carbon dioxide, are given in Table I. The original oil had an iodine number of 161, was of dark red color and had a putrid odor.

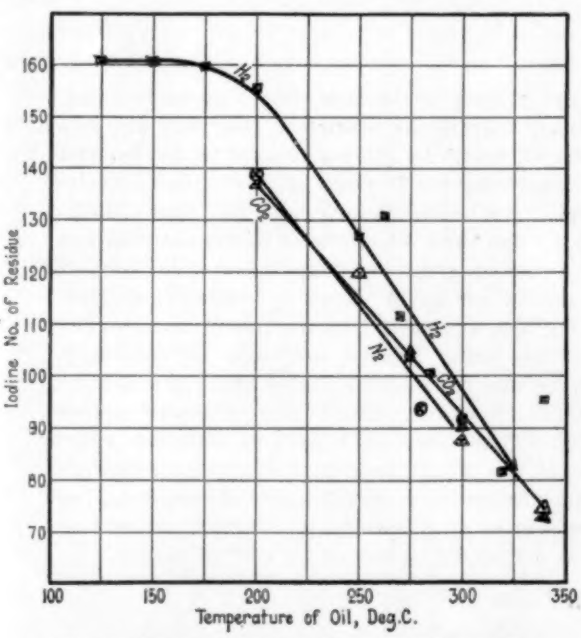


Fig. 1—Change in Iodine Value of Salmon Oil With Inert Gas Treatment

Table I—Distillation Data

Sample No.	Gas Used	Temp. Oil, Deg. C.	Vol. Gas, Cu.Ft.	I No.	Color	Odor	Name of Observer
1	H_2	125	....	161	Red	Putrid	W. P. Heintz
2	H_2	150	....	161	Brown	Putrid	W. P. Heintz
3	H_2	175	....	160	Brown	Improved	W. P. Heintz
4	H_2	200	....	156	Dark brown	Faint	W. P. Heintz
5	H_2	250	....	127	Dark brown	Faint	W. P. Heintz
6	H_2	260	5.4	131	Clear	Faint	N. H. Nelson
7	H_2	270	8.4	112	Clear	Faint	N. H. Nelson
8	H_2	275	8.6	104	Dark	Very faint	N. H. Nelson
9	H_2	285	9.7	101	Dark	Very faint	N. H. Nelson
10	H_2	320	4.5	84	Very dark	Very faint	N. H. Nelson
11	H_2	340	....	Decomposition			
12	N_2	200	1.7	139	Red	Putrid	Katherine Lloyd
13	N_2	280	8.0	94	Dark	Faint	N. H. Nelson
14	N_2	300	4.5	92	Dark	Faint	N. H. Nelson
15	CO_2	200	1.7	137	Red	Putrid	Katherine Lloyd
16	CO_2	250	1.7	120	Red	Faint	Katherine Lloyd
17	CO_2	275	1.7	105	Dark	Faint	Katherine Lloyd
18	CO_2	300	1.7	88	Dark	Very faint	Katherine Lloyd
19	CO_2	325	1.7	80	Dark	Very faint	Katherine Lloyd
20	CO_2	340	....	Decomposition			

Table II—Quantity and Iodine Values of Distillate Obtained With CO_2

Sample No.	Temp., Deg. C.	Wt. of Distillate, Grams	Iodine No.
1	200	0.5	86.2
2	250	0.9	70.7
3	275	1.6	80.9
4	300	3.2	91.0
5	325	7.0	83.0
6	340	...	73.0

An attempt was made to determine the quantity and composition of the distillate obtained which was solid at all temperatures except that of decomposition. Time permitted only the determination of the quantity and the iodine number in connection with the use of carbon dioxide as the inert gas. The results, which are somewhat variable, are given in Table II.

When the iodine values of the various residues obtained by passing an inert gas through the salmon oil at a given temperature for 3 hours are plotted against such temperatures, Fig. 1, it will be noted that the iodine value decreases with an increase in temperature in all cases, becoming a straight line function above 200 deg. C. It was noted that with such decrease of iodine value occurs an increase in viscosity, a lessening of the odor and a darkening in color. The changes in the oil are apparently independent of the volume of the gas used, the same iodine values being obtained with 9.7 cu.ft. as with 1.7 cu.ft.

From these results it appears that the change in properties is not due to hydrogenation but rather to a fractional distillation, with the inert gas acting as a washing or scrubbing agent to remove the components of the oil volatile at a given temperature. It will be interesting to study next the composition and properties of the fractions thus removed.

Glue Production Runs Normal

The Department of Commerce announces that, according to data collected by the Bureau of the Census, there was produced during the second quarter (April-June) of 1924 a total of 24,450,500 lb. of glue of animal origin, of which amount 15,876,700 lb. represents hide glue; 2,344,700 lb. extracted bone glue, and 6,229,100 lb. other bone glue, as compared with a total production during the first quarter (January-March) of 28,701,100 lb., representing 17,246,700, 3,618,900 and 7,835,500 lb., respectively, of hide glue, extracted bone glue and other bone glue. The total production in 1923 was 109,061,800 lb., while in 1922 a total of 94,641,000 lb. was produced.

Is Plasticity of Practical Value?

The Symposium on This Subject a Feature of the Lafayette Centennial—Indicates That It Is a Useful Tool in Many Industries

Editorial Staff Report

LAST week was gala week at Easton. Lafayette College celebrated its 100th anniversary and honored two chemists with academic degrees. One was Edgar F. Smith, former president of the American Chemical Society, and the other Edward Hart, Professor of Chemistry at Lafayette College. A celebration and dinner were tendered Dr. Hart on the completion of fifty years of teaching at Lafayette. The occasion was memorable and many leaders of the chemical profession, including seven former presidents of the American Chemical Society, attended to pay their respects to Dr. Hart.

Following this a symposium on the general subject of plasticity, organized by Prof. E. C. Bingham of Lafayette, brought the festivities to a close and furnished an appropriate technical feature for the occasion.

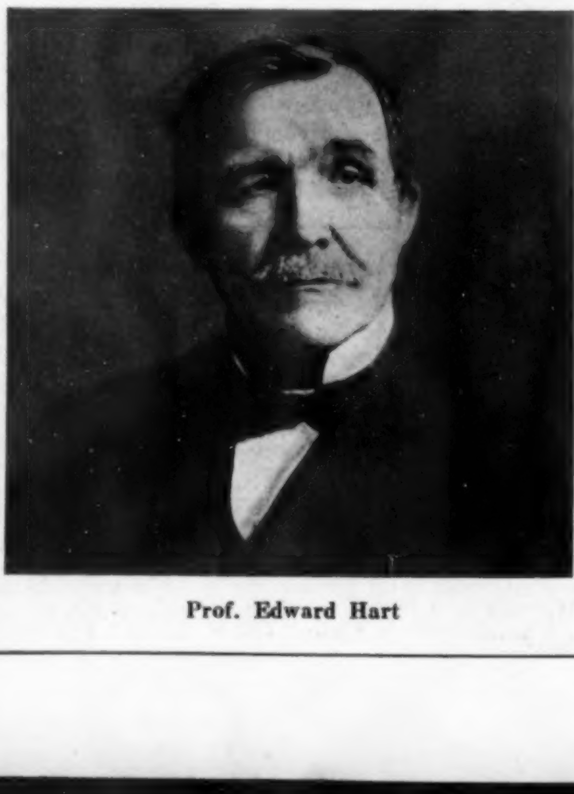
There was once a young lady—a college graduate—who was studying in a law office. She was doing stenographic work on the side to help out her pocketbook. One of her tasks happened to be a doctor's thesis in chemistry and when the task was completed she admitted that she had understood not a single word of the dissertation.

The task of reporting intelligently a symposium on plasticity resembles in some lesser degree the copying of that doctor's thesis. Part of this is due to the confusion that has arisen about the technical terminology. This confusion is natural and inevitable when many workers tackle a new field. Yet it is none the less bewildering to a technical man or a scientist who approaches the subject for the first time. Part of the difficulty is due to the subject itself, which though capable of qualitative expression and generalization is extremely difficult to discuss quantitatively, because of the complicated and at best approximate mathematical relationships. Plasticity in its present state recalls colloids during the early life of the subject.

Plasticity is a word familiar to everyone and is used industrially to describe clays such as are used in ceramic ware. It refers to the workability of the clay. In the chemical sense it is much more definite in meaning and much more comprehensive and inclusive in its application. Liquid or fluid systems, if that expression can be used with some latitude, are either viscous or plastic. If they are viscous they behave as true liquids, whereas if they are plastic they exhibit a resistance to flow that is called yield value and is capable of at least relative measurement. When force equivalent to the yield value has been exerted the material flows with a definite "mobility." These two properties of yield value and mobility define plasticity. It is a valuable scientific concept and has already opened up many avenues of intelligent approach to the study of matter.

This is an extremely crude definition of the subject but it will perhaps be adequate as a background for the present discussion.

For simplicity the papers may be divided into two classes although most of them fall into both. The first class deals primarily with the technique of plasticity measurement and the fundamental conceptions of the



Prof. Edward Hart

Bucks County is the best county in the country. At least, that is the sentiment that was put into Dr. Hart's mouth by the toastmaster at the banquet commemorating his 50 years of service at Lafayette College. But Bucks County was Dr. Hart's birthplace. From there he migrated to Philadelphia and in the face of great handicaps he won for himself a sound knowledge of chemistry without collegiate training and went with Thomas Drown to Lafayette when the latter became professor of chemistry. Later he won his Doctor's degree under Ira Remsen at Johns Hopkins without any previous college degree. That much of history is sufficient guarantee of the signal success that was to follow as teacher beloved by generations of students; as manufacturer of chemicals; as inventor; as author, and as a splendid citizen of the city of Easton.

subject. The second group takes up the applications of plasticity to industry and the needs of industry in this respect. It is not wholly appropriate and rather impossible adequately to discuss the experimental methods used and scientific principles evolved. Yet there are several points worth noting. Plasticity measurements can be obtained from a variety of different apparatus such as for example viscometers and capillary tubes as well as the various modifications of the Bingham platometer. It is only necessary to measure a shearing stress on the material in some way. Of course the accuracy of the various methods is not the same but that may be suited to the need of the experiment. P. M. Giesy and E. Moness of E. R. Squibb and Sons described a plastometer used for measuring the plasticity of dental creams, made entirely out of standard pipe fittings and a capillary tube that gave results sufficiently accurate for control work on these materials. W. H. Herschel of the Bureau of Standards touched on one phase of the work at the Bureau—the use of the Oswald viscometer as a consistometer. At that point the symposium digressed to discuss consistency. Although everyone agreed that Mr. Herschel was measuring something and that the result would have a decisive bearing on the ultimate mathematical expression of the plasticity relationship yet they could not agree on what consistency was. Returning to methods nearly every paper described some method of measuring the shearing stress and the resulting flow or elongation as the case might be. On plotting these values curves for plastic substance are obtained, the upper part of which are straight lines and do not go through the point of origin. By extrapolating this linear part to the horizontal axis the yield value is obtained and the mobility is measured by the scope of that line. A viscous material on the other hand would yield a line going through the point of origin.

Of what use is this property plasticity? It is of value in the manufacture of artificial silk. C. S. Venable of the Viscose Co. reported on viscose silk, the finished product, and on the viscose solutions from which the silk is spun. These latter have small yield value and small plasticity, so small that for practical purposes it can be disregarded and the solutions regarded as liquids. The viscosity of these solutions is an essential control in factory operation. The finished silk on the other hand is plastic and if the elongation of the fibre is plotted against the load that is used to stretch it, a characteristic plasticity curve is obtained. The practical value of this lies in the fact that the mobility and yield value vary with the origin of the material.

S. E. Sheppard of Eastman Kodak Co. spoke of their comprehensive attempt to correlate the history of the cellulose with the properties of films and the solutions from which films are made. Already interesting results have been obtained pointing to possible intermediate class of fluids between viscous and plastic. To this class, if it is a class, cellulose nitrate and acetate probably belong, although plastic curves have been obtained with the nitrate.

Standards for Starch

Chemical analysis of starch has been superseded as a criterion of quality by measurement of yield value and mobility. C. E. Berquist of Corn Products Refining Co. pointed out the inadequacy of chemical analysis and the inadvisability of the jelly test or the viscometer test as they both operated under conditions under which the starch is not used—high temperature and mobility. By using the plastometer standards can be set for commercial starch based on yield value and mobility that give promise of successful control.

The use of plasticity measurements in controlling dental impression compounds was pointed out by W. S. Crowell of S. S. White Dental Co. and Mr. Sheppard reported on some gelatine work at Eastman.

R. H. Bogue, now of the Portland Cement Association Laboratory, developed the idea of the possible usefulness of plasticity in the manufacture of glue or rather in the study and control of the product. Glue goes over from a gel to a sol at approximately 30 deg. It would be logical to assume that the gel would be plastic and the sol viscous but it is not so simple as that. Below 10 deg. it seems to behave as if it were pure gel and above 30 deg.-34 deg. as a sol by many different methods of measurement. Between the two there is probably a mixture.

Frank G. Breyer, New Jersey Zinc Co., made a plea for uniformity of nomenclature and pointed out the difficulty of selling the plasticity idea to the practical paint man when there is so much vagueness. It is essential to translate mathematical conceptions into simple English so that yield value and mobility will mean something. Plasticity measurement is very important in paint production for it is the only ultimate difference between a flat paint and an enamel. Practical results are already obtained by using knowledge of the mechanism of plasticity in both varnish and paint production.

W. D. Bancroft of Cornell reported on some work with clays and how the plasticity had been remarkably increased by the addition of 0.25 per cent lithium chloride. So much so in fact that kaolin had become as plastic as a good grade of ball clay.

Harry N. Holmes of Oberlin College talked most interestingly on emulsions. He elaborated the absorption film theory of emulsions and analyzed the properties of films at the interface of two liquids which would tend to form emulsions. The film must be elastic and quick forming and he showed many experiments in which such films would or would not be formed and obtained emulsions or not as the case might be.

Wheeler P. Davey of the General Electric Co. showed another side of plasticity with a paper on metals. There are four types of crystal structure considered from the point of view of atomic arrangement; cubical, such as sodium chloride; body centered with one atom in the center of each cube, such as iron and tungsten; face-centered with one atom in the center of each face of the cube, such as copper, silver and gold; and complex structure called a triangular close packed lattice such as zinc and cadmium. By studying these crystals under X-rays it has been possible to show why cubical crystals would be brittle, face centered crystals are ductile and easily drawn and rolled, and why the body centered crystals are intermediate while triangular close packed crystals are brittle. Ordinary metals are masses of crystals and in order to simplify the study large single crystals of metals were prepared and studied—a single crystal of copper six inches in length can be bent by the fingers of one hand into a U but it requires two hands to bend the crystal straight for the simple structure has been destroyed and the atomic planes destroyed. This was a single item in a paper full of interest and promise.

Equipment News
From Maker and User

Sieve for Making Accurate Samples

The machine shown above, developed by the Sturtevant Mill Co., Boston, Mass., is for the purpose of replacing uncertain hand labor in the screening of test samples. It is called a "Test Sieve." It is claimed not only that it gives accuracy in sieving and time but that it also can produce from two to thirteen products at a single operation by the use of from one to twelve half-height sieves, or, when using one to six full-height sieves, from two to seven products may be secured. Sieve diameters vary from 6 to 10 in. By the setting of a time switch, the operation of the sieve is made entirely automatic. The machine, complete with motor, is ready to run when delivered, being supplied with current from an ordinary light circuit. It is built heavy, to withstand intense vibration of small amplitude.

Sectional Tubular Condenser

An interesting condenser, serving many purposes and of particular moment to the petroleum refinery field, is the new G-R sectional condenser, manufactured by the Griscom-Russell Co., 90 West St., New York.

This apparatus, which is built in two or more sections, will operate as a standard, reflux or partial condenser, and can also be used as a condenser and heat exchanger at the same time. For standard operation, the vapor enters the upper shell and passes down through the successive sections over the banks of tubes through which water, oil or other circulating liquid is flowing. Used as a reflux or partial condenser, the vapor enters the bottom vapor connection, passing upward through the vapor inlet, and the lighter fractions leaving the upper outlet.

A still further arrangement of this condenser obtains a different "cut" or "fractionation" from each section. The lower vapor connection of each section can be offset to the side of the shell, and the distillate can be drained from the basin thus formed in the vapor space. Besides flexibility of arrangement, flexibility of capacity is also obtained by adding as many sections as desired.

This condenser is compact, rugged, and can easily be transported and assembled. Special features of construction provide easy cleaning and inspection without disconnecting water piping, and the use of rolled steel tube sheets prevents cracked plates or leaky tubes.

Speed Reducer

High-speed turbines and motors, which are rapidly coming into general use because of their compactness and economy, require a speed-reducing mechanism when driving low-speed machinery such as compressors, generators, refrigerating machines, pumps, conveyors, crushers, etc. The ideal speed reducer should transmit the load noiselessly, without shocks or loss of power, and should be compact and require minimum attention.

A speed reducer has been recently developed that, it is claimed, meets these requirements. The load is transmitted from the high-speed shaft through planetary gears to a slower rotating annular ring. Inside this ring are connected a number of rockers, which engage with a spider keyed to the low-speed shaft. As the driving motor or turbine starts up, each of the rockers engaging with the teeth of the spider first compresses a spring plunger, which brings the bottom of the rocker into positive contact with the inside of the annular ring and at the same time brings its side into positive contact with the side of the adjacent spider tooth.

During the time required to compress the spring plungers, corresponding to about one-quarter of a revolution, there is practically no load on the turbine or motor, and the load is then transmitted gradually and without starting shock. The spring plungers also serve to eliminate vibration and backlash, thereby assisting quiet operation. The low-speed shaft to which the spider is keyed is supported on both sides of the spider. The pinion on the high-speed shaft is allowed to float and adjust itself to the proper position between the planetary gears, thus preventing side strains or unequal stresses and assuring perfect torque.

The speed reducer is totally inclosed, so as to be dustproof and foolproof, and all parts run in oil, with forced lubrication above 1,800 r.p.m. It can be applied to either step-up or step-down speed change, and is furnished in ratios from 4:1 to 200:1 and for any load up to 500 hp. This device is manufactured by the Meachem Gear Corporation, 122 Dickenson St., Syracuse, N. Y.

Manufacturers' Latest Publications

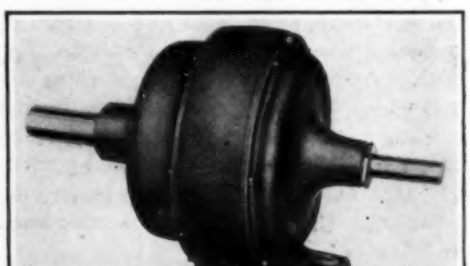
Detroit Electric Furnace Co., Detroit, Mich.—A booklet entitled "Speedier Production—Better Brass," which describes in detail the advantages, performance and results obtained with this company's electric brass furnace in the brass melting field.

McCord Radiator & Mfg. Co., Detroit, Mich.—Catalog 17. A catalog of the McKim gaskets, copper for general use, steam, water, air and internal combustion engines; aluminum for acid; steel for boiler handholes; tin, zinc and Monel for various chemical plant purposes and numerous other types.

Edward Valve & Mfg. Co., East Chicago, Ind.—A new catalog of valves for oil refinery service under condition of high pressure and temperature.

Interior of Speed Reducer

The speed reducer shown in these two pictures is novel in the means taken to insure starting without loss of power and without shock.



Speed Reducer Assembled

The spider and rockers shown in the view on the left act as a clutch to insure positive starting without slip or clash.

Review of Recent Patents

Oxidizing Hydrogen Sulphide

Silica gel is suggested by Hanns Carstens, Alfred Engelhardt and Wolf J. Müller, of Leverkusen, Germany, as catalyst for the oxidation of sulphur according to the equation:

$$2H_2S + O_2 = 2H_2O + 2S$$

Silica gel effects a smooth oxidation and is not oxidizable, as is activated carbon, which has also been proposed for this work.

As an example, generator gas having a content of about 3 grams of hydrogen sulphide in 1 cu.m. is mixed with 1 per cent by volume of air (reckoned on the whole gas mixture) and after admixing 0.01 gram of ammonia per cu.m. is passed through a layer of highly porous silicic acid. When the mass of the silicic acid has become saturated with sulphur, hydrogen sulphide will appear in the issuing gas. The gas to be treated is then switched on to another silicic acid layer and the sulphur from the first layer is recovered by extracting with hot chlorbenzene from which the sulphur is precipitated on cooling in the form of crystals. It is filtered and freed from the adhering chlorbenzene by steaming and dried. The extracted silicic acid is likewise freed from any chlorbenzene by steaming and can then again be used as a gas-purifying material. (1,507,105, assigned to Farbenfabriken vorm. Friedr. Bayer & Co., Leverkusen, Germany, Sept., 2, 1924.)

Making Cellulose Ethers

Paul C. Seel, of Rochester, N. Y., obtains an intimate mixture of cellulose, alkali and water suitable for the production of transparent films by the following process:

Cotton, wood cellulose or cellulose tissue (100 parts) is charged into a disintegrating mill along with 250 parts of water and 200 parts of caustic soda. The mill may be of any commercial kind, the blades of which are driven at a very high speed. A current of air is moved through the mill and carries away the entirely mixed and shredded fibers, caustic soda and water. This material is then collected from such air current and is found to be in a state which allows the etherifying reaction to proceed on practically every fiber of the mass. It is charged into an autoclave with 400 parts of ethyl chloride for each 100 parts of cellulose in the mixture. The autoclave is then heated for, say, 24 hours at temperatures between 90 and 170 deg. C. (1,507,201, assigned to Eastman Kodak Co., Rochester, N. Y., Sept. 2, 1924.)

Continuous Wall Board Process

Quick-setting plaster and ordinary pulp board paper are used in a continuous wall board process developed by J. A. Buttress and G. A. Buttress, of Los Angeles, Calif., instead of the slow-setting plaster and waterproofed facing sheets ordinarily used.

Plaster of paris, sawdust, dextrine and water are mixed to form an adhesive quick-setting plaster composition. This is spread by trowel on the lower facing sheet, and together with the upper facing sheet, passed through rollers to form a continuous board about 11/16 in. thick. As the plastic swells to its fullest extent in about 3 minutes and the board moves 25 ft.

U. S. Patents Issued Oct. 7, 1924

Method of Pulverizing and Mill Therefor. Daniel V. Sherban, Canton, O., assignor to the Bonnot Co., Canton, O.—Re-issue 15,930.

Process of Regenerating Base-Exchange Silicates. Thomas R. Duggan, New York, N. Y., assignor to the Permutit Co., New York.—1,510,469.

Adhesive and Sealing Strip Having a Coating of the Same. Frederick W. Farrell, Brookfield, Mass.—1,510,472.

Production of Carbon Black. George C. Lewis, New Dorp, N. Y., assignor to Columbian Carbon Co., Williamsport, Pa.—1,510,485.

Furnace. Victor Tanier, Sclaigneaux, Belgium.—1,510,510.

Glass. Fred M. Locke, Victor, N. Y.—1,510,521.

Production of Butyl Alcohol and Acetone by the Fermentation of Molasses. Guy C. Robinson, Stanford, Conn., assignor to Atlas Powder Co., Wilmington, Del.—1,510,526.

Detonating or Disruptive Explosive. Frederich Olsen, Dover, N. J.—1,510,555.

Tunnel Kiln. John B. Owens, Zanesville, O.—1,510,556.

Filter. Ernest J. Sweetland, Montclair, N. J., assignor to United Filters Corp., New York.—1,510,568.

Regenerative Furnace. Ambrose N. Diehl and Samuel G. Worton, Duquesne, Pa.—1,510,588.

Shell or Cartridge Case. Frank A. Fahrenwald, Cleveland Heights, O.—1,510,590.

Adhesive. Frederick W. Farrell, Brookfield, Mass., assignor, by mesne assignments, to McLaurin-Jones Co., Brookfield, Mass.—1,510,591.

Catalyst and Process of Producing the Same. Alfred T. Larson, Washington, D. C., assignor to Arthur B. Lamb, trustee, Cambridge, Mass.—1,510,598.

Food Product. Cecil O. Phillips, New York, N. Y., assignor to the American Cotton Oil Co., New York.—1,510,606.

Process of and Apparatus for Drying Comminuted or Sheet Material. Joseph H. Walsh, Boston, Mass., assignor to Johns-Manville Inc., New York.—1,510,615.

Centrifugal Agitator and Process of Making the Same. Edgar B. Nichols, Rochester, N. Y., assignor to the Pfaudler Co., Rochester, N. Y.—1,510,630.

Continuous-Distillation Device. Elie J. Vermeyen, Choisy-le-Roi, France.—1,510,636.

Process for Vulcanizing Rubber and Products Obtained Thereby. Sidney M. Cadwell, Leonia, N. J., assignor to the Naugatuck Chemical Co.—1,510,652.

Art of Preserving Fruit. Samson Katzprowsky, New York, N. Y.—1,510,679.

Process of Reclaiming Rubber. Joseph H. Russell, Naugatuck, Conn., assignor to Rubber Regenerating Co.—1,510,706.

Device for Handling Plastic Brick. Halver R. Straight, Adel, Ia.—1,510,717.

Destructive-Distillation Process. Perley S. Wilcox, Kingsport, Tenn., assignor to Eastman Kodak Co., Rochester, N. Y.—1,510,730.

Cellulose-Ether Purification. Richard Baybutt, Rochester, N. Y., assignor to Eastman Kodak Co., Rochester.—1,510,735.

These patents have been selected from the latest available issue of the "Official Gazette" of the United States Patent Office because they appear to have pertinent interest for "Chem. & Met." readers. They will be studied later by "Chem. & Met.'s staff, and those which, in our judgment, are most worthy, will be published in abstract.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Process of Removing Water from Nitrocellulose Fibers. Robert W. Cook, Rochester, N. Y., assignor to Eastman Kodak Co., Rochester.—1,510,739.

Method of Refrigeration. Paul H. Buch and Howard M. Groff, Trenton, N. J.—1,510,759.

Process for the Production of Pressed Masses, Molded Articles and the Like from Compounds of Cellulose With an Organic Substance. Richard Hermann, Berlin, Germany, assignor by mesne assignments, to American Cellone Co., Inc., New York.—1,510,779.

Paper-Pulp Shredder. William F. Hussey, Waterville, Me., assignor to Waterville Iron Works, Waterville.—1,510,782.

Manufacture of Chlorhydrins. Karl P. McElroy, Washington, D. C., assignor, by mesne assignments, to Carbide & Carbon Chemicals Corp.—1,510,790.

Apparatus for Liquefying and Separating Gas Mixtures. Rudolf Mewes, Berlin, Germany.—1,510,793.

Cement Paint. Spencer B. Newberry, Cleveland, O., assignor to the Medusa Cement Paint Co., Cleveland.—1,510,795.

Method of Purifying Solutions of Viscose and Similar Solutions of Cellulose. Jacob R. N. van Kregten, Arnhem, Netherlands, assignor to Naamlooze Vennootschap Nederlandsche Kunstzijdefabriek, Arnhem, Netherlands.—1,510,810.

Enamel Composition. Hugh S. Cooper, Cleveland, O., assignor to Kemet Laboratories Co., Inc.—1,510,829.

Method of Making Fibrous Pulp from Low-Cost Vegetable Matter. Mark W. Marsden, Philadelphia, Pa.—1,510,855.

Recuperator Coke-Oven Structure. Julius K. Munster, Carnegie, Pa., assignor to the Koppers Co., Pittsburgh, Pa.—1,510,857.

Process of Making Cyanides. Irwin S. Joseph, Rahway, N. J.—1,510,891.

Process of Pressure Distillation. Robert J. Black, Kansas City, Kan.—1,510,918.

Heat-Treatment Apparatus. Walter G. Perkins, London, England.—1,510,956.

Method of Concentrating Oil Shales. Samuel H. Dolbear, San Francisco, Calif., assignor of one-half to Edwin L. Oliver, San Francisco.—1,510,983.

Vulcanization Apparatus. Hadley F. Freeman, Milwaukee, Wis., assignor, by mesne assignments, to the Fisk Rubber Co., Chicopee Falls, Mass.—1,510,987.

Method for the Production of Molded Articles and So Forth from Casein and the Like. David C. Polden, Surbiton, England.—1,511,003.

Art of Treating Cast Iron. Samuel B. Pack, Washington, D. C.—1,511,063.

Pyrazolone Dye. Leon W. Geller, Hamburg, N. Y., assignor to National Aniline & Chemical Co., Inc., New York, N. Y.—1,511,074.

Cast-Iron Alloy. Hiroshi Shiokawa, Kobe, Japan.—1,511,142.

Decarbonizing Compound. Gerald P. Young, Dayton, O.—1,511,152.

Apparatus for Uniting Metals. Lynn S. Burgett, Cleveland, O.—1,511,189.

Process of Producing Coke. Ray P. Perry, Upper Montclair, N. J., assignor to the Barrett Co.—1,511,192.

Process of Uniting Metals. John B. Austin, Cleveland, O.—1,511,194.

Process of Uniting Copper to Steel. John P. Austin, Cleveland, O.—1,511,195.

Process of Uniting Metals. John B. Austin, Cleveland, O.—1,511,196.

Process of Uniting Copper to Steel. John B. Austin, Cleveland, O.—1,511,197.

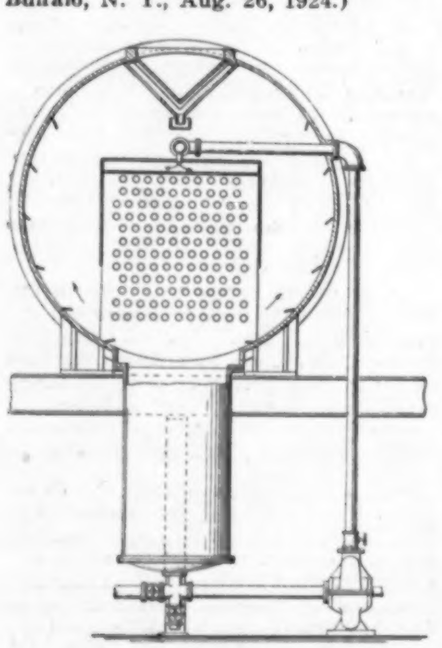
per minute, a set of ironing rollers is placed about 75 ft. from the forming rollers. The board is reduced in thickness to about ¼ in. A further run of 75 ft. provides for initial drying and the board is then cut, trimmed and dried in a kiln at 130 deg. F. for 18 to 20 hours. Aside from this final drying the whole operation takes only about 12 minutes. (1,507,332, assigned to Rex Goodcell, Los Angeles, Sept. 2, 1924.)

Film Evaporator

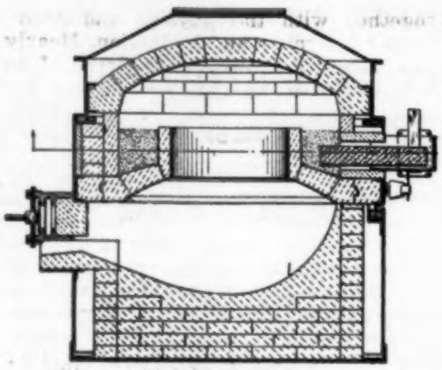
Burton S. Hughes, of Buffalo, N. Y., has found that the efficiency of a film evaporator may be materially increased by causing the vapors to flow downward or in the direction of flow of the liquid being concentrated. The tubes are inclosed on top and sides so that the vapor must pass downward before escaping into the vapor space of the evaporator, where it rises to an outlet in the top. Longitudinal ribs on the inside of the evaporator shell and baffle plates with staggered openings placed just below the outlet separate any liquid that might be carried by the vapors.

The tubes are so arranged that they can be replaced easily. The openings in the tube sheets are somewhat larger than the tubes and are recessed to take packing, which is forced steam-tight by means of gaskets and packing plates bolted to the tube sheets. The packing plates are rectangular and serve to clamp the gaskets surrounding at least four tubes. Defective tubes may be cut out by means of plugs, making it possible to operate even if no substitute tube is available.

The liquid to be evaporated is circulated continuously over the tubes until the desired concentration is reached. By increasing the rate of circulation it is possible to reduce the time of contact of liquid with the tubes so that sensitive materials may be handled without danger of overheating. (1,506,001, assigned to Zaremba Co., Buffalo, N. Y., Aug. 26, 1924.)



Film Evaporator



Electric Furnace

Granular Resistance Furnace

Ease of replacement characterizes the electric granular resistance furnace developed by Thaddeus F. Baily, of Alliance, Ohio. Above the furnace hearth is a removable annular section built up of carborundum blocks so as to provide a trough in which the granular carbonaceous resistance material is placed. Suitable electrodes imbedded in the resistance material serve as electrical leads. The roof of the furnace rests in sand seals on top of the heating section. This construction leaves the entire hearth unobstructed. When the resistance trough burns out it can be lifted from the hearth and replaced at once by a new resistance section. (1,506,281, Aug. 26, 1924.)

Sulphur Dioxide for Extinguishing Fires

Sulphur dioxide has many properties that entitle it to consideration as a fire-extinguishing agent. For use in this connection, Frank W. Andrews, of Wapakoneta, Ohio, first purifies the gas in order to remove sulphur trioxide, sulphuric acid and other impurities. Gas from a commercial cylinder is passed through a charcoal and pumice stone filter and recompressed until it liquefies. The liquid is charged into 2½-lb. cylinders. The addition of 2 to 8 per cent carbon tetrachloride will produce a heavier gas that will settle more quickly but may be objectionable in some cases, as it produces considerable smoke. (1,506,963, Sept. 2, 1924.)

Book Reviews

The Science of Metals

THE SCIENCE OF METALS. By *Zay Jeffries*, consulting metallurgist, Aluminum Co. of America, and *Robert S. Archer*, metallurgist, research bureau, Aluminum Co. of America. 500 pages, 200 illustrations. McGraw-Hill Book Co., New York. Price, $5.

There is a vast difference between a work that is written for the purpose of presenting the results of research and one that is written for the purpose of assisting others to understand and apply the results of research and experience. The fact that many of Jeffries and Archer's articles in the technical literature have been writings of the first type may give the prospective reader of their new book a feeling of hesitancy, a belief that the work of authors of such high authority must be the most difficult of reading. Nothing could be farther from the facts of the case; the book is an almost perfect example of easy reading, pleasing presentation of a branch of science.

"The Science of Metals" is intended to be useful as a text book; if one begins at the beginning, a high school education is enough to make the book understandable. It is also intended to be a book that will be useful and profitable to those of more experience in the field of physical metallurgy.

In the preface the authors say: "It is a common fallacy to mistake the complex for the profound. It is also quite common to assume that the advanced is difficult. The present treatise is of an advanced nature in that it presents much of the latest information. It is our object, however, to render the treatment not more difficult but more simple." They have succeeded.

While the book is primarily an exposition of general principles, the material used for illustrative purposes is of a distinctly practical nature. The extent to which the various metals and alloys are discussed is about in proportion to their industrial importance. The practical slant of the engineer who is every day up against industrial problems is to be seen in every chapter.

To begin to describe the contents of "The Science of Metals" would be futile. It must suffice to say that the completeness with which the field is covered amply justifies the title that the authors have chosen.

CLIFFORD B. BELLIS.

Popular Fallacies

POPULAR FALLACIES EXPLAINED AND CORRECTED. By *A. S. E. Ackermann*. Third edition. 1,000 pages. J. B. Lippincott Co., Philadelphia.

What a lot of things aren't so! Here is a book which an English engineer has taken the pains to compile and which lists hundreds of popular beliefs that the author states are untrue. He classifies the items under twenty-five heads, ranging from astronomy, biography and biology to the weather, but including also sections on literature, history and law—about which an engineer is supposed to know little or nothing.

The very first fallacy listed is: That a thaw bursts water pipes. The freezing of the water does the bursting, says the author; the thaw only reveals the rent in the pipe. Other items listed under "domestic" are: that tin utensils

are made entirely of tin; that steam is visible; that rooms warmed by gas-stoves are unhealthful; that a dark wrapper necessarily means a strong cigar and a light wrapper a mild one, and that the longer and whiter the ash the better the cigar. Each of these fallacies is corrected in about half a page of explanation.

The section entitled "engineering and science" is 150 pages long. In it are such items as the following: that sea-water never freezes; that common salt is much more soluble in hot water than in cold; that underground water can be found by use of a divining rod; that chamois leather is customarily made from chamois skin; that an explosion of gunpowder acts upward, and of dynamite downward; that damp air is heavier than dry air; that any angle can be trisected geometrically by Euclidean methods; that when a candle flame is extinguished by a soap bubble it is due solely to the surface tension of the bubble; that oxidation of matter in water goes on only at the surface in contact with the air; that it is possible to see many thousands of stars with the naked eye (only about 2,000 are visible at any one time and place); that the hardening of metals by hammering is due to closing up the interstices and that heat opens these; that lightning rods do more harm than good and if used they should be insulated from the building; that the hardening of copper is a lost art; that dew falls; that in transmitting compressed air the losses are high.

Under "literature" the author points out that the saying "God tempers the wind to the shorn lamb" is not a quotation from the Bible. Under "history" he shows that if Cleopatra dissolved a pearl in vinger to drink to the health of Antony, she must have first pulverized it with a hard hammer and a strong arm, or the dissolving would have required several days. I recommend the book as a substitute for mah jongg, bridge or cross-word puzzles.

P. B. McDONALD.

Books Received

Lime and Magnesia

LIME AND MAGNESIA: THE CHEMISTRY, MANUFACTURE AND USES OF THE OXIDES, HYDROXIDES AND CARBONATES OF CALCIUM AND MAGNESIUM. By *N. V. S. Knibbs*, chief chemist, the Denny Chemical Engineering Co., Ltd., and the Callow Rock Lime Co., Ltd. 300 pages, illustrated. Ernest Benn, Ltd., London; D. Van Nostrand Co., New York. Price, $7.50.

Those who have occasion to study the technical literature covering the manufacture of various industrial chemicals are frequently surprised to find that many common, widely used commodities have been almost entirely neglected. This has been particularly true of the lime industry, and Mr. Knibbs' comprehensive survey is most welcome. As indicated by the subtitle, the book is divided into three parts. The first covers the general chemistry, analysis, physical and chemical properties of lime and magnesia, together with the physics and chemistry of burning and hydration. Nearly 100 pages are devoted in Part II to manufacturing operations, giving many practical details. The rest of the book is a thorough discussion of uses.

Business Writing

PRINCIPLES OF BUSINESS WRITING. By *T. H. Bailey Whipple*, literary critic, Westinghouse Electric & Manufacturing Co. Westinghouse Night School Press, East Pittsburgh, Pa.

This is another book emphasizing the fact that good business and technical writing has been too much neglected both by technical colleges and by large business institutions. The chapters of the book were originally written for the Westinghouse force, but the demand for it from schools of technology, the author says in the preface, made publication in booklet form necessary, and in 4 years the booklet has run through as many editions. Although intended primarily for the business letter writer, there is much in the booklet that could be read with profit by the technical man who desires to state his thoughts in writing as forcefully and clearly as possible.

Readers' Views

Modified Process for Pulping Wood

To the Editor of Chem. & Met.:

Sir—Your editorial in the Sept. 15 issue, on a modified process for pulping wood, is timely, particularly in view of the recent figures published by the U. S. Forest Service, which show that our pulpwood supply is diminishing rapidly.

There is nothing essentially new in semi-cooking processes, but we have made the mistake of assuming that our forests were inexhaustible and so have made no serious efforts to improve our pulping processes by introducing treatments that would give high yields and good quality. Now that we face a real shortage in pulpwood Necessity must bring her daughter Invention to the front where she can point the way.

The Forest Products Laboratory has done some excellent pioneer work in this field, both in the semi-kraft and semi-sulphite cooks, and has shown that we may expect a very materially increased yield by these processes and probably a reduction in costs. The mechanical disintegration of the softened chips presents the greatest difficulty, but this is gradually being overcome.

Another promising field that should not be forgotten is the use of micro-organisms which act on the non-cellulose constituents of the wood cell and leave the cellulose intact. Some work has already been done along these lines, but very careful investigation may open up the way for fundamentally different methods of making pulp. It is increasingly apparent that basic improvements in the industry can be realized only by some concerted and comprehensive research.

Cornell, Wis. ALLEN ABRAMS.

Important Technical Articles in Foreign Literature

"Thermal Measurements in Glass Works." *H. Maurach*. Use of thermoelements and radiation pyrometers; heat changes in melting and cooling. *Chem.-Ztg.*, Sept. 16, 1924, p. 657.

"Durability of Refractories in the Glass Industry." *K. Endell*. Physical and chemical corrosion; effects of batch composition, temperature and other factors. *Chem.-Ztg.*, Sept. 16, 1924, p. 657.

"Distillation and Gasification of Lignite." *Conrad Arnemann*. Photographs and diagrams of several types of ovens; comparison of kinds and amounts of products. The Lurgi and the Arnemann ovens are the best. *Z. für angewandte Chem.*, Sept. 11, 1924, pp. 713-21.

"High-Pressure Steam in Chemical Technology." *Bruno Schulz*. Uses and advantages; description and diagram of apparatus for pressures up to 212 atm. *Chem.-Ztg.*, Aug. 28, 1924, pp. 602-3.

"A New Method for Direct and Simultaneous Recovery of All Fractions Chemically Pure." *Viktor Freund*. The cooling liquid for each unit of the still is chosen so that its boiling point is identical with that of the highest boiling constituent of the vapor passing that unit. *Chem.-Ztg.*, Aug. 28, 1924, pp. 603-4.

"Investigation of Crude Tar and Its Products." *Erich Koch*. The advantages of low-temperature carbonization; utilization of poor coking coals; refining of low-temperature tars; production of motor fuels. *Chem.-Ztg.*, Aug. 20, 1924, p. 581-2.

"A New Synthetic Colloid." *Fritz Pollak* and *Kurt Ripper*. Condensation of aldehydes with urea yields colorless resins, of which pollapas (formaldehyde urea) is the most important. It has many potential uses, chiefly depending on its optical properties and its transparency to ultra-violet light. *Chem.-Ztg.*, Aug. 14 and 20, 1924, pp. 569-71 and 582-5. (See U. S. Pat. 1,507,624, Sept. 9, 1924.)

Reversibility of the Reactions in the Lead Chamber Process. *Andre Graire*. Experimental proof that the reaction by which H_2SO_4 is formed in the lead chamber is reversible. The ordinary equilibrium laws are not sufficient to account for these reactions. *Comptes rendus*, Aug. 18, 1924, pp. 397-400.

"Fertilizing Value of Various Phosphates." *H. Niklas, A. Strobel* and *K. Scharrer*. Phosphates have decreasing value as fertilizer in the order: superphosphate, Rhenania phosphate, dicalcium phosphate, thomas slag. The first three are nearly equivalent. *Z. für angewandte Chem.*, Aug. 14, 1924, pp. 617-20.

News of the Industry

Summary of the Week

Committee representing oil producers establishes basis of agreement with Mexican Government.

Phosphate Export Association makes formal request for federal aid to maintain export business.

British Board of Trade issues adverse report on proposed association of British and German dye interests.

Tariff Commission is expected to complete its report on linseed oil as soon as the sugar case has been settled.

All branches of the industry were represented in the American Gas Association's convention last week at Atlantic City.

Bureau of Mines announces comprehensive schedule for metallurgical research in connection with different universities.

U. S. Tariff Commission will require $1,000,000 for the next fiscal year to conduct investigations under flexible features of the tariff law.

Scarcity of Helium Emphasized by Arrival of "ZR-3"

To fill the "ZR-3" with helium will require the use of most of the army's supply of that gas. As this is written, no determination has been made by the War Department of the action it will take. The War Department has its own active program of experimentation with lighter-than-air ships and it may not be willing to turn this gas over to the navy, although it may do so in view of the fact that the army is greatly interested in the development of aircraft of the Zeppelin type.

Some criticism has been expressed because the navy did not have sufficient helium available to fill the "ZR-3." In that connection it was pointed out that helium production is only emerging from an experimental state. These two large rigid ships hold practically a year's production at the present rate. In addition, there must be reserves to take care of the losses incident to repurification and seepage from the gas bags themselves. Legislation looking to increased production and reserves of helium has not received Congressional approval.

Much of the criticism seems to come from a former employee of the Chemical Division of the Bureau of Mines, who, in connection with his charges of incompetency with the helium program, alleges waste through the payment of exorbitant salaries. Since all of the helium work is under the reclassification schedule, that charge is refuted by the very general conclusion, in official and other quarters, that the scale of salaries in the technical services is entirely inadequate. The technical men who have been working on helium are very ready to admit that many of their experiments were failures, but in view of the uncharted course they have been following, they feel fairly well satisfied with the percentage of successful results they have obtained. Only one research laboratory has been established and it already has furnished data in connection with the solubility of helium which have permitted the design of production plant No. 2 to go along more scientific lines, to say nothing of the possible advantage that may have been taken of these data in the improvement of plant No. 1.

The failure of the "ZR-3" to continue in flight over American cities until it would have covered a total of 5,000 miles, as had been planned, is taken to indicate lack of confidence in hydrogen.

Fundamental Research in Cast Iron at Michigan

In connection with the new engineering building at the University of Michigan, Ann Arbor, the department is engaging upon an extensive study of the fundamental properties of cast irons, utilizing the exceptional foundry, metallurgical and chemical laboratory facilities provided in the structure. The progress made up to the present time indicates that important results will be derived in the endeavor to determine which basic properties are responsible for the different and decided variations in the strength of cast iron. The equipment in the engineering building is suitable for carrying through investigations and experiments in the line of erosion and corrosion resisting cast irons; heat resisting cast irons; malleable cast irons; measurement of melting and pouring temperatures; cupola practice; molding sands; facing sands, and the like. In addition, facilities are available for undertaking investigations on core oils and core binders in general. Along the latter lines, some preliminary research has been made with regard to the properties of commercial core oils, and a definite program is being developed for this work to ascertain a standard test procedure for determining the qualities of same. It is purposed to raise a sufficient fund to carry out this work.

Tariff Commission Will Require Larger Budget Next Year

Investigations by the Tariff Commission which have grown out of the flexible provisions of the tariff act have greatly increased the operating cost of the commission and will make it imperative that a larger appropriation be made for this work during the next fiscal year. Chairman Marvin stated last week that $1,000,000 would be needed to conduct investigations during the coming year and to meet the usual expenses of the commission.

Last Wednesday Mr. Marvin laid before the President the situation growing out of the allotment of funds tentatively made the commission by the Bureau of the Budget, the amount being less than provided by Congress for the current fiscal year.

He stated that it has required all of the funds provided by Congress the last few years to meet expenditures. This year the commission had before it 183 applications, ordering investigations in about forty cases and disposing of about sixty without investigations. The remaining cases could not be handled because of lack of personnel and of funds.

The 1924 appropriation amounted to $742,000, of which $20,000 was specifically provided for printing and a part of the balance to pay the bonus to civilian employees. There remained a net amount of $680,000. The appropriation for the current fiscal year was $671,000 and it is proposed by the Budget Bureau to make further cuts for next year. Mr. Marvin called attention to the fact that the work of the commission would necessarily be confined if the tentative appropriation was adhered to. He stated that funds must be available if further investigations are ordered and announced that fifteen new applications had been received since the beginning of the present fiscal year with thirty investigations now under way.

News in Brief

Ceramic Course at North Carolina State College — Arrangements have been made for a few students to take instruction this school year in ceramic engineering at the North Carolina State College of Agriculture and Engineering. A complete curriculum will be offered in the subject beginning the next school year. A complete ceramic laboratory will be installed and research work in the ceramic natural resources of the state will be undertaken. It is also being planned to offer extension work in the subject to clay workers and clay and feldspar miners of the state, and this work will include a week's instruction during the winter in clayworking and ceramics at the college.

Cement Works Are Active—Cement mills in the Lehigh Valley section of Pennsylvania are maintaining manufacture under peak output, and the material is being shipped as fast as it is produced. Every plant is on the active list. With little or no opportunity to stock up, the storage departments at the various plants are practically empty. Shipments during the past 30 days are holding up the same high record as in weeks during the summer, and it is expected that 1924 will be a record-breaking year for distribution.

Important Hearing for Oil Permits and Leases—A hearing involving millions of dollars in permits and leases covering the south half of the Red River oil field in Oklahoma will begin on November 10 before Secretary Work of the Interior Department. There are 178 applications for permits and leases, all of which represent claims filed before the Supreme Court declared it was public land belonging to the government. Many of these claimants had already drilled wells, making it necessary for the Supreme Court to operate them through a receivership, which was recently concluded. The Secretary of the Interior was authorized to take over the proceeds and decide which applicants were equitably entitled to permits and leases by virtue of possession and expenditures on the land prior to Feb. 25, 1920.

Glass Production Increased in 1923—The Department of Commerce announces that, according to the data collected at the biennial census of manufactures, 1923, the establishments engaged in the manufacture of glass reported products valued at $308,828,914, an increase of 44.7 per cent as compared with $213,471,309 in 1921, the last preceding census year. The total for 1923 was made up as follows: Building glass, $121,235,241; bottles, jars, etc., including demijohns and carboys, $107,230,589; pressed and blown glass, including jelly glasses, tumblers and goblets, $77,279,007; all other products, $3,084,077.

India Produces Methanol—The Mysore Government wood distillation works commenced operations during January, 1923, and a statement of the production for a period of almost a year shows an output of 108,190 gal. of methanol, 835 tons acetate, 1,488 tons tar and 2,250 tons of neutral oil. The distillation of pure beverage alcohol is not an important industry in India.

Canada Considers Tax on Water Powers—Officials of the Department of Lands and Forests of Ontario are discussing a proposal to impose a general tax on all water powers in the province. A bill introduced last year proposed a tax levy on water powers, machinery and other properties in connection with mines, pulp mills and other industries. It was later claimed a mistake had been made in drafting the measure, and it was withdrawn. Present proposals are said to involve a general tax upon all water power developed at a fixed rate per horsepower, this to be in addition to the water rentals levied in the leases from the crown for the use of water, where such rentals are charged.

Kaolin Deposits in Nova Scotia—An important discovery of kaolin has been made near Victoria Beach, in the North Mountains, Annapolis County, Nova Scotia. A similar deposit was also found in the South Mountains, said to contain about 40 per cent of kaolin. The exact extent of the deposits has not yet been determined and further surveys are to be made early next spring.

Salts in Smoke Injure Slate Roof—Salts contained in the soot from an oil burner were found by the Bureau of Standards to be the cause of extensive decay in the slate roof of the building in which the burner was housed. These salts, being soluble in water, were leached into the slate by the rains and were recrystallized in dry weather. The formation of the crystals tends to pry the particles of slate apart and produces an effect similar to frost action only much more severe.

Czech Alcohol Manufacturers to Enlarge Output—The quantity of alcohol which the Czech alcohol manufacturers will be authorized by the government to produce in the coming year has not yet definitely been agreed upon, but will probably amount to 500,000 to 550,000 hectoliters. The contingent for the year 1923-1924 was 400,000 hectoliters. The producers estimate the needs for 1924-25 at 624,000 hectoliters of which 106,000 are for export. Trade reports indicate that exports have recently met with difficulty, owing to pressure of German supplies on the market. It is reported that the German monopoly sold recently 40,000 hectoliters in Switzerland at a price of from 28 to 30 Swiss francs per hectoliter, and a lot of 25,000 hectoliters to Canada at a price of 16½ to 17 Dutch guilders.

Norway Re-establishes Production of Arsenic

According to advices to the American Chemical Society, re-establishment of arsenic ore production in Norway has taken place. The world's demand for arsenic has been increasing for some time owing to the extensive use of arsenic trioxide in agriculture, and so the prices on arsenic ores have shown a rising tendency. In northern Norway there are several large deposits of arsenopyrites containing 25 to 35 per cent of arsenic. After the war it was not possible to work the mines with a profit, but recent higher prices caused a change in this situation, and the owners will start working some of the mines in the near future. It has not been decided, however, whether the ore is to be exported as such or in the form of manufactured arsenic.

Oil Companies in Mexico Reach Agreement With Government

Advices from Mexico state that a Treasury Department statement was issued last week to the effect that an agreement had been reached on the fundamental points in the long-standing controversy between the oil companies and the government.

The agreement is reported to have been reached as a result of conferences between government officials and a committee representing oil producers in Mexico. The official statement stated that the conferences among the Mexican Finance Minister, the Under Secretary of Industry and Commerce, other officials and the committee of oil men ended Oct. 15. They were carried on in an atmosphere of frankness, cordiality and good will, and as the result of such favorable conditions an agreement has been reached on the fundamental points in the long-standing controversy between the oil companies and the government, harmonizing for mutual benefit the interests of the companies and the rights of the government, and establishing, according to the belief of both parties, a basis for the future development of the Mexican oil industry. The basis reached must naturally be submitted to the President of the republic and the oil companies.

Canada Will Sell Timber for Paper Making

The Canadian Government is advertising large timber limits for sale in Manitoba. Tenders are to be received on or about Dec. 16. The limits will not be sold except to persons capable of going ahead with the development, and a marked check for $100,000 is required with the tender. The agreement further will provide for the erection on the limits or at some place approved by the Minister of the Interior of a pulp and paper mill, costing not less than $2,000,000, with a daily output of not less than 100 tons of pulpwood, 50 tons of which shall be made into paper at the mill.

While J. D. McArthur is not mentioned, the action of the government is taken to expedite the launching of a big pulp mill which the former railway contractor has organized.

Washington News

Muscle Shoals Problem Puzzles Officials

Disposition of This Property Held to Be Congressional and Not Executive Matter

Thus far in the consideration of the disposition of the government's properties at Muscle Shoals chief attention has centered on the Ford offer. Such consideration as has been given alternative propositions has been entirely incidental to the analysis of the Ford offer. As a result of the withdrawal of Mr. Ford's proposal a situation is created in which there is little crystallization of opinion in official quarters as to which of the alternatives is best.

At the White House it was stated that the President still is of the opinion that a determination of the matter can be approached best through a commission to be composed of a sub-committee of the Senate Committee on Agriculture, which has jurisdiction in the upper house, and a sub-commitee of the Committee on Military Affairs, which has jurisdiction in the lower house of Congress. Commerce Secretary Hoover, realizing the difficulty of reaching a business-like determination of an engineering problem by a political commission, suggests that an "objectively minded and skilled" committee also be employed. It is assumed that such a committee would act in a consulting capacity for the Congressional commission. It was emphasized at the White House that the disposition of this property is a Congressional and not an Executive matter.

Opposition to Commission Idea

Some opposition to the commission idea is expressed by those who fear that such a procedure will inevitably result in withholding the property from utilization for a year or more after it is ready to deliver power. Some are of the opinion that a better way to handle the matter would be to vest full responsibility for the working out of the problem in the Secretary of War. Secretary Weeks is recognized as possessing unusual business ability. The Corps of Engineers, which built the dam, could operate it without any important excursion into government operation. With the assistance of the Chief of Engineers, the Chief of Ordnance and such outside advice as he would summon, a prompt determination could be made as to the disposition of the power. Another suggestion is that a corporation composed of the Southern power companies should be allowed to make an application for rights under the water-power act.

If a joint committee of Congress undertakes the study of the matter, it is pointed out, it would be late in the forthcoming short session before recommendations could be worked out, particularly if that committee had to wait on a report from a committee of engineers. The chances are much against any legislation of a controversial character that is submitted late in the short session, when practically all of the time will be consumed with appropriation bills, which have right of way.

Power Available June 15

The plant at Muscle Shoals will be ready to deliver power on June 15. If Congress should refuse to delegate the responsibility of handling the problem either to the Secretary of War or to the Federal Power Commission, the necessary legislation might have to go over until the session of Congress, which would meet in December of next year. If the present administration is returned there probably will be no extra session of Congress. In the event of a change in administration an extra session would be a certainty and earlier Congressional action might be secured, but even then a certain amount of delay would be inevitable.

In all probability the Senate will recommit the Norris bill, which is on its calendar. While there was considerable support for this measure when the principal purpose was to head off the Ford bill, there would be little chance of putting this legislation through the Senate and less of putting it through the House under existing conditions.

Revised Figures for Arsenic Output of Canada

Vice-Consul G. Bruce Andrews, Montreal, has submitted revised figures for Canadian production of arsenic in 1923, showing a production of 7,334,202 lb., valued at $883,771, compared with 5,152,000 lb., valued at $321,037, in 1922. The 1923 production includes 6,071,232 lb. of white arsenic reported by the silver smelters in Ontario and 1,217,970 lb. from the British Columbia smelters.

Gain in Manufacture of Paste and Adhesives

The Department of Commerce announces that, according to the data collected at the biennial census of manufactures, 1923, the establishments engaged primarily in the manufacture of mucilage, paste, and other adhesives, not including glue, reported a total output valued at $10,621,218, an increase of 7 per cent as compared with 1921, the last preceding census year. This classification covers establishments manufacturing sticking and gumming preparations, made for the most part of gum arabic, dextrin, or other adhesive materials and various kinds of adhesive cements and sealing compounds, not including glue, for which there is a separate industry classification.

In addition, a considerable amount of mucilage, paste, etc., is manufactured by establishments engaged primarily in other industries. The value of such commodities thus produced outside the industry proper in 1921 was $1,445,174, an amount equal to 14.6 per cent of the total value of products reported for the industry as classified. The corresponding value for 1923 has not yet been ascertained but will be shown in the final reports of the present census.

Tests Show Superiority of Chrome Tanning

The final results of four series of wear tests conducted by the Bureau of Standards for comparing the durability of chrome- and vegetable-tanned sole leathers have been compiled, as follows:

Series	Days Wear Per Iron: Chrome	Days Wear Per Iron: Vegetable	Per Cent Greater Wear of the Chrome Leather
1	10.1	8.2	23.2
2	23.9	11.3	111.5
3	16.0	11.4	40.3
5	20.9	9.7	115.5

The chrome leather in series 1 and 3 was filled with grease and mineral salt, in series 2 the natural chrome was used, and in series 5 the chrome leather was filled with paraffin.

Report on Linseed Oil May Recommend Lower Duty

As soon as the sugar case, which has been monopolizing attention several months, is out of the way, the Tariff Commission is expected to get to work on its report to the President giving results of its investigation into linseed oil, as the result of an application for a reduction in duty.

While there has been no official indication of what the conclusions of the commission in the linseed case will be, a report pointing toward a lower duty would not be surprising to those who have followed the course of this inquiry.

One of the surprising features of this case was the testimony of one witness, which is emphasized in the brief presented to the commission by a committee representing domestic crushers, to the effect that a low duty on linseed oil in all probability would bring about a system of "seaboard plus price," which would place a burden upon the American producer of flaxseed and the oil consumer in the Middle West. In view of the decision of the Federal Trade Commission in the Pittsburgh plus price case involving the United States Steel Corporation, there might be considerable room for doubt about a "seaboard plus" system of price quotations on linseed oil.

It was contended by the crushers at the hearing, and in their brief, that at present varying prices of linseed oil are determined by the cost of domestic seed, plus competitive conditions, and that if this were not so, prices at all times would be equivalent to the cost of foreign seed, plus transportation, plus the tariff duty and plus inland transportation.

Specifications for Inks

United States master specifications for record and copying ink, for writing ink, for red ink, and for stamp pad ink have been prepared by the Federal Specifications Board and have been published, respectively, as Circulars 182, 183, 184 and 185 of the Bureau of Standards.

Gas Association Convention Sets New Records

Atlantic City Meeting of A.G.A. Replete With Discussions and Exhibits of Engineering Interest

The enthusiasm of exceptional attendance and unusually fine exhibits made the sixth annual convention of the American Gas Association an unqualified success last week. The meetings at Atlantic City from October 13 to 17 were further evidence of the great advantage of a single association for the whole industry. There management, engineering, commercial, accounting and other branches of the business all gathered, not only to exchange ideas on the specialties of each, but also to study the other fellow's problems in gas supply for industrial and domestic users.

The technical reports and extensive exhibits were replete with valuable information for the chemical engineer in many industries other than gas manufacture. A detailed and illustrated report of these phases of the convention will appear in *Chem. & Met.* at an early date.

Association Affairs of Interest

The work of the past 12 months under the presidency of John B. Klumpp, of Philadelphia, has been extended to several new fields of technical interest. A budget of more than $300,000 for the year, as reported by the treasurer, shows the magnitude of association work; and a substantial growth in company and individual membership is shown.

The officers elected to serve for 1924-25 were: President, Harry C. Abell, New York City; vice-president, Charles L. Holman, St. Louis; treasurer, H. M. Brundage, New York City (re-elected). The technical section of the association will be headed by R. C. Cornish, American Gas Co., Philadelphia, as chairman and H. P. Haftenkamp, Rochester Gas & Electric Corporation, Rochester, N. Y., as vice-chairman. The corresponding officers of the industrial gas section will be H. O. Lobell, Combustion Utilities Corporation, New York City, and F. F. Cauley, Peoples Gas Light & Coke Co., Chicago.

The convention in 1925 will, by decision of the meeting, be held during the first half of October at Atlantic City, in order to have the exhibition facilities of the Steel Pier again available to manufacturers of gas-making and gas-burning equipment.

Some interesting statistics of the gas industry were made public for the first time by Alexander Forward, secretary-manager of the association. As evidence of continued growth of the industry, he pointed out that the output last year passed the 400 billion cu.ft. mark for the first time. In connection with sales he showed that 24.02 per cent (or slightly over 92,000,000,000 cu.ft.) of the total sales for 1923 was for industrial purposes. In 1921 industrial sales were but 21.62 per cent, or a little more than 70,000,000,000 cu.ft. On the basis of quantity this is an increase of 30 per cent. Another significant comparison is to be had with 1913, when sales were but half those of 1923. Of the increase during this 10-year period, industrial sales accounted for 47 per cent.

The following brief table, based on latest available data, gives an excellent view of the production situation:

ESTIMATED PRODUCTION OF MANUFACTURED GAS
(Thousands of Cubic Feet)

	1923	1922	Increase 1923
Carburetted water gas	230,206,000	222,372,000	7,834,000
Coal gas	58,885,000	53,166,000	5,719,000
Oil gas	24,627,000	25,144,000	....
Coke-oven gas purchased and distributed for public use (Coke-oven gas consumed at point of production or for purposes other than public use is not included)	65,872,000	52,883,000	12,989,000
Total manufactured gas	379,590,000	353,565,000	....
Natural gas purchased and mixed with manufactured gas for public use	38,410,000	35,435,000	2,975,000
Grand total	418,000,000	389,000,000	29,000,000
Number of meters — prepayment	870,993	....	....
Number of meters — ordinary	9,040,151	....	....
Total meters	9,911,144	9,474,000	437,000
Number of consumers	9,800,034	9,373,000	427,000
Miles of gas main	76,917	73,400	3,500

The attitude of the gas industry toward the purchase of coke-oven gas for city distribution was well stated by Mr. Klumpp in his presidential address. He pointed out that although this plan should not always be necessary, it is nevertheless attractive and workable where the gas company is not in a position to finance plant extensions of its own. Bulk purchase of gas is increasing, and, according to Mr. Klumpp, we may expect to see further developments along this line just as we have seen large electric generating stations erected to sell current in quantities, thus displacing smaller stations.

He further declared: "The byproduct coke oven in some form is here to stay and offers many advantages to the gas man in supplying him with gas in bulk, provided the ovens are operated with care and some consideration is given to the gas company's interests. A constant and assured supply of gas to the utility is necessary or a contract for the purchase of gas cannot be advantageously made. A guaranteed supply of gas of uniform quality can demand a higher price under contract than a supply that is irregular and uncertain.

"The coke-oven plant cannot be a successful investment unless it finds a ready and substantial market for its coke, and where this market is obtained through the domestic trade, the coke consumer must be given satisfactory service and his supply must be protected and not withdrawn when other markets temporarily offer a more favorable return.

British Board of Trade Opposes Anglo-German Dye Merger

To offset the increased competition which American chemical manufacturers will have to meet as a result of the new order of affairs in Germany comes the news that the British Board of Trade has reported adversely on the proposed association of British and German dye interests, and that the German chemical industry must work against what it contends to be an unfair proportion of the reparations burden.

The action of the British Board of Trade is known to have been influenced to a considerable extent by public opinion. Undoubtedly the proposed agreement, it is believed in Washington, would have been in the interest of the shareholders of the British Dyestuffs Corporation. In fairness to them, it would seem here that the public which objects to the merging of the British and German dye industries should be willing to agree to any steps necessary to the establishment of a permanent industry that can stand alone.

Oil and Natural Gas Leases Filed in Canada

Oil and natural gas leases amounting to approximately 25,000 acres have been filed on lands between Fort Vermillion and the Vermillion chutes, Canada, by S. E. Slipper, formerly geologist with the federal government but who is now acting in the interests of some unknown parties. Work was done in the district some years ago by the Lord Rhondda interests, it being understood that there was a possibility of obtaining oil at a depth of between 600 and 700 ft.

United States Largest Consumer of Mineral Oil

Of total world mineral oil consumption in 1923 of over 38,000,000,000 gal., the United States consumed 25,000,000,000 gal., or 66 per cent, in addition to bunker oil supplied at United States ports to vessels engaged in foreign trade, which totaled 1,579,000,000 gal., bringing American requirements to over 70 per cent of world total. Great Britain, though second largest consumer, used but 3.9 per cent of the world's total.

Copper Sulphate Used for Dipping Nets

Consul General A. E. Ingram at Vancouver reports that a considerable quantity of sulphate of copper is used in British Columbia for dipping nets used in the salmon fisheries. The supply of this commodity is chiefly brought from Great Britain and northern Europe, often as ballast. The market for insecticides lately has been supplied from Canadian sources. Contracts for these commodities are usually made in November and December for arrivals in the early spring.

Trade Notes

The United Ammonia Co. has been incorporated at Dover, Del., with a capitalization of $300,000. Incorporators are A. W. Marshal, John P. Shea and John R. Dolan.

H. D. Ruhm, of New York, and several friends have organized a small holding corporation, to be known as the Ruhm Phosphate & Chemical Co., Mt. Pleasant, Tenn., for the future development of a large area of oil shale and phosphate lands in Tennessee.

The production this year of citrate of lime in Italy was barely 6,000 tons, or about half of last year's. The Camera Agrumaria has fixed the minimum price of 425 lire for the makers and sells at 525 lire per 100 kilo, basis 64 per cent citric acid. This years's entire production has already been sold, and stocks of the Camera Agrumaria are reported to be about 18,000 tons.

The B. F. Goodrich Co. announces the appointment of George B. Campion as manager of Goodrich mechanical sales at Akron, Ohio. Mr. Campion was formerly district sales manager at New York, and succeeded T. A. Bonnott, who has been appointed manager of the products control department, new goods division.

A. R. Clarke & Co., Toronto, Canada, have prepared plans for a tannery to cost $100,000. Work will be commenced in November.

Proctor K. Malin has succeeded E. D. Winkworth as president of the Solvay Process Co., Semet-Solvay Co. and the Atmospheric Nitrogen Co. George M. Wells succeeds Mr. Malin as vice-president of the Solvay Process Co.

Mail Orders More Prominent in Foreign Trade

While competition in foreign markets is expected to become increasingly keen from this time forward, advices reaching Washington from a large proportion of the foreign centers where we maintain consulates indicate that American products are so well established that more than a small price differential is going to be necessary to dislodge them. A reputation has been established for quality and for fair dealing. There is a general preference among merchants to be the avenue for the sale of American goods. A cross-section from consular reports indicates that the great increase in American prestige since the war is being reflected in a public demand throughout the world for American products.

Another significant trend in foreign trade is a general awakening on the part of individuals to the fact that they can order small quantities of nearly any article by mail from the country in which it is made. The aggregate of this business is becoming very large. Americans too are learning that mail orders can be placed abroad, as is indicated by the rapid increases in mail importations.

Federal Aid Sought to Hold Phosphate Export Trade

Proposed Agreement Between France and Germany and Shipping Rates Are Points at Issue

In an effort to meet what it regards to be unfair competition the Phosphate Export Association has appealed formally to the Federal Government, asking that its influence be used to prevent an agreement between France and Germany, under which the latter country would take all of its phosphate requirements from Morocco. An appeal also has been made to the Emergency Fleet Corporation asking that the $3 rate on phosphate be restored.

The export association has advices from Germany indicating that negotiations are pending that may result in the exclusion of American phosphate from the German market. Any such accord would be a very severe blow to the American industry, which before the war was shipping annually nearly a million and a half tons of American phosphate to Europe. While exports since the war have been somewhat less, the trade still is a large one. In 1923, exports of Florida pebble totaled 598,128 tons, while those of hard rock phosphate aggregated 191,222 tons.

Expert Survey Favorable

Last year the export association sent two engineers to Morocco to study the situation. They reported that American phosphate could compete successfully with the Moroccan product in Europe, with the possible exception of the countries bordering on the Mediterranean. That report, however, was based on the ocean freight rate existing at that time. Since then the rate has risen from $3 to $4.75. In addition to a certain amount of direct subsidy, it is understood that the French Government is omitting tax collections and subsidizing the industry in other indirect ways. As a result, the Moroccan output, which was 8,232 tons in 1921, will amount to 400,000 tons in 1924. The estimated output for 1925 is 550,000 tons. The 1926 production is expected to be 600,000 tons, which will be the full capacity of the works now completed and under construction.

The ocean freight rate situation is blamed by the export association for most of their trouble. When the $3 rate was in effect the Moroccan interests were disposed to enter into a price agreement or a fair division of territory in Europe. Plans were made for conferences in this country during the past summer. Before the time set for the conferences, however, ocean freight rates went up and the Moroccan industry immediately lost interest. Thorough-going economies, however, have been effected by the American producers and they now are absorbing the freight increase and are delivering their products abroad at the old price. This has had the effect of arousing the Moroccan interests to the point where they again are desirous to enter into a discussion of the matter of agreements.

The export association contends that it is in the interest of American industry to have the $3 rate restored. It is pointed out that the present demand for shipping will not continue after the grain movement and that it would be only fair to protect the shippers of commodities whose forwardings are not seasonal. It also is pointed out that failure at this critical time to secure lower ocean rates may allow American phosphate to be driven out of the European market—a position which if once lost might never again be regained.

Financial

The Shawsheen Mills, of Andover, Mass., the $2,000,000 capital stock of which is owned by the American Woolen Co., reports net loss of $432,349 for year ended June 30.

The Commercial Solvents Co. has declared a dividend of $1 on Class A stock on account of accumulated dividends. This clears up all accumulations.

The Cudahy Packing Co. has declared regular semi-annual dividends of 3 per cent on 6 per cent preferred and 3½ per cent on 7 per cent preferred.

Shareholders of the Canadian Industrial Alcohol Co., Ltd., have ratified a resolution calling for the sale to a new company of the same name for consideration of 800,000 shares of the new company of no par value. Shareholders of the old company will receive two new shares for each share of $25 stock now held.

A report from Montreal says that the Saguenay Pulp & Power Co. is to be reorganized. The new company will be known as the Quebec Pulp & Power Corporation and will take over the present company and its subsidiary, the Chicoutimi Pulp Co. There will be an exchange of A bonds and a complete financial rehabilitation. There will be $7,000,000 bonds to be exchanged and a public issue of $1,000,000.

At a special meeting held last week, stockholders of the Pennok Oil Co. ratified the plan for liquidation and dissolution. The plan calls for the purchase of 150,000 shares, at $1 a share, of no par stock of Pennok Oil Corporation, a new company, and payment of this stock as a liquidating dividend to old company holders at rate of one new company share for three old company shares. Physical properties of the old company are to be sold to the new company for $2,250,000 three year 6 per cent notes.

Large Surplus Stocks of Coke at Byproduct Plants

Manufacturers of byproduct coke accumulated stocks of unsold coke during the first 8 months of 1924, and on September 1 a group of 21 plants had on hand a record total of 1,114,000 tons. This was an increase of nearly 45 per cent over the stocks on January 1, 1924, and it exceeded the previous high mark established on March 1, 1922, by more than 10 per cent.

Bureau of Mines Announces Metallurgical Program

Research and Experimental Work Will Be Carried Out in Co-operation With Universities

Assignment of the metallurgical work of the Bureau of Mines is as follows: Ore dressing research and experiments in sizing, crushing and grinding, Salt Lake City station, in co-operation with the department of metallurgical research of the University of Utah; service tests on metals used in connection with ore dressing and milling processes, Salt Lake City station, in co-operation with the department of metallurgical research of the University of Utah; metals used in crushing and grinding machinery, Minneapolis station, in co-operation with the University of Minnesota; beneficiation of ferrous ores, Southern Experiment station, in co-operation with the University of Alabama; flotation, Salt Lake City station, in co-operation with the University of Utah; beneficiation of lead and zinc ores of the Mississippi Valley, Rolla station, in co-operation with the Missouri School of Mines; classification of non-ferrous ores, Moscow station, in co-operation with the University of Idaho and the operators of the Cœur d'Alene district; coal washing in Eastern and Central states, Pittsburgh station, in co-operation with the Carnegie Institute of Technology and with coal operators.

Program in the West

Coal washing in the Pacific Coast states, Seattle station, in co-operation with the University of Washington; work with the experimental blast and electric furnaces and laboratory and field investigations in connection with the manufacture of iron and steel, Minneapolis station, in co-operation with the University of Minnesota and with the industry; direct processes of steel manufacture, Seattle station, in co-operation with the University of Washington; open-hearth and bessemer processes, Pittsburgh and Minneapolis stations, in co-operation with the University of Minnesota and the industry; experiments with electric furnace steel, Minneapolis station, in co-operation with the University of Utah; problems of recovering gold and silver from their ores, Reno station, in co-operation with the University of Nevada; utilization of silver and silver alloys, Washington, D. C., in co-operation with the Bureau of Standards.

Pyrometallurgy of copper, Tuscon station, in co-operation with the Universities of Arizona and of Utah; hydrometallurgy of copper, Tuscon station, in co-operation with the University of Arizona; pyrometallurgy and hydrometallurgy of lead, Berkeley station; pyrometallurgy of zinc, Rolla station, in co-operation with the Missouri School of Mines; hydrometallurgy of zinc, Berkeley station; loss of metals in slags, Tuscon and Salt Lake City stations, in co-operation with the Universities of Arizona and Utah; microscopic studies of complex ores, Salt Lake City station, in co-operation with the University of Utah; aluminum research, Seattle station; electrometallurgical processes, Seattle station, in co-operation with the University of Washington; physics, mathematics and chemistry of metallurgical problems, Berkeley station; metallurgical requirements for refractories, Seattle station, in co-operation with the University of Washington and the Ohio State University; utilization of fuels, Pittsburgh station; application of oxygen to metallurgy, Pittsburgh station; applied physics, Minneapolis station; heat-treatment of oil well equipment, Minneapolis station.

Survey of Quinine Industry

Samuel H. Cross, commercial attaché at The Hague, has issued, as a supplement to *Commerce Reports*, a pamphlet on the production and marketing of quinine. It is a comprehensive survey of the quinine industry. With regard to stocks he states that the available supply of quinine during 1923 may be estimated in the vicinity of 20,000,000 oz., including the following: Java bark shipments to the Netherlands, British India, and miscellaneous, 9,000,000 oz. (bark equivalent); Java shipments from British-controlled plantations to Howards & Sons (Ltd.), 1,250,000 oz.; Java shipments to the Hoshi-Kyodo interests, 1,250,000 oz.; Indian salt production, 1,000,000 oz.; Java quinine shipments, 5,000,000 oz.; bark stocks in Amsterdam, 1,000,000 oz.; and stocks in Java, 500,000 oz. Inclusion of London stocks and a possible larger estimate of Java stocks might well raise this figure by between 1,000,000 and 1,500,000 oz., and the absence of data from the Dutch syndicate renders such estimates exceedingly approximate, and acceptable only with considerable reserve. The main deficiency in the market rises from the absence of Russian quinine consumption, amounting before the revolution to about 2,500,000 oz. annually, while the financial situation of Central Europe and the Balkans is also not without a corresponding reaction. There is thus no doubt that the world market is at present oversupplied.

Calendar

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, Smithsonian Institution, Washington, D. C., Dec. 29 to Jan. 3.

AMERICAN ASSOCIATION TEXTILE CHEMISTS AND COLORISTS, Bellevue-Stratford, Philadelphia, Dec. 6.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, Hotel Shenley, Pittsburgh, Pa., Dec. 3 to 6.

AMERICAN IRON & STEEL INSTITUTE, Hotel Commodore, New York, Oct. 24.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York, Dec. 1 to 4.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS, New York, Dec. 1 to 3.

ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS, Hotel Raleigh, Washington, D. C., Oct. 20 to 22.

FOREST PRODUCTS UTILIZATION CONFERENCE, National Museum, Washington, Nov. 19 to 20.

MANAGEMENT WEEK. Auspices of American Society of Mechanical Engineers, New York City, Oct. 20 to 25.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING, Grand Central Palace, New York, Dec. 1 to 4.

SOUTHERN EXPOSITION, Grand Central Palace, New York, Jan. 19 to 31, 1925.

Personal

Prof. HENRI ABRAHAMS, director of the physics laboratory, University of Paris, Paris, France, gave an instructive address recently in the theater at the College of Fine Arts, Carnegie Institute of Technology, Pittsburgh, Pa., on the subject, "Measurement of Time." Dr. Abrahams also attended the centenary celebration of the Franklin Institute, Philadelphia, and the Rensselaer Polytechnic Institute, Troy, and visited the Westport mill of the Dorr Co.

ARTHUR R. CADE has left Pittsburgh, where he has been for several years as a Fellow in the Mellon Institute, to accept a position with the Lavoris Chemical Co., Minneapolis. Mr. Cade has already begun work in his new position.

E. W. EDWARDS, head of the Pringle Turpentine Co. and other industries in Cincinnati, Ohio, has assumed his duties as president of the Paragon Refining Co., Toledo, Ohio, petroleum refiner, to which office he was elected recently.

W. F. EVANS, of the New Jersey Zinc Co., Palmerton, Pa., gave an interesting address on Oct. 11 before the members of the Lehigh County Historical Society, Friedensville, Pa., descriptive of the Friedensville zinc mines and operation.

ARNOLD FIEDLER, of Hamburg, N. Y., has accepted a position as plant manager for the Peltier Glass Co., at Ottawa, Ill.

SEVERN M. FREY has been transferred from the Buffalo Linde Air Laboratories to the Niagara Falls plant of the Carbide & Carbon Chemicals Corporation.

ARTHUR W. KIMMAN, for several years metallurgist at the Precision Castings Co., Inc., Fayetteville, N. Y., and F. C. WHEELER, formerly metallurgist at the H. H. Franklin Manufacturing Co., Syracuse, N. Y., have opened an office at 122 Dickerson St., Syracuse, N. Y., as consulting chemists and metallurgists.

ROY A. LEWIS, general manager of the Bethlehem Steel Co., Bethlehem, Pa., has joined the staff of lecturers at Lehigh University. WINTHROP O. HEARSEY, superintendent of the service department of the same company, has also become a member of the staff of lecturers.

JOHN R. MCDOWELL, formerly associated with the Willys-Morrow Co., Elmira, N. Y., is now connected with the Corning Glass Works, Corning, N. Y.

Prof. ALEXANDER SILVERMAN, head of the department of chemistry, University of Pittsburgh, Pittsburgh, Pa., gave an address on Oct. 8, broadcast by radio, on the subject "The Place of Chemistry in Everyday Life." He will give another talk at a later date on the topic of "Glass—One of Man's Blessings."

Market Conditions

German Producers Advance Shipment Prices for Caustic Potash

Recent Agreement Among Producers Eliminates Competition—Weighted Index Number Higher for the Week

REPORTS that German producers of caustic potash had entered into an agreement to control prices and production have been current in recent weeks and higher shipment prices had been awaited. Last week verification of these reports was found in cable advices quoting forward deliveries on a higher price basis. This is another result of the elimination of competitive selling on the part of foreign producers through the establishment of trade agreements.

Inquiry for chemicals has not reached a stage where it may be called active but industrial activities continue to increase and gradual improvement is noted in the movement of raw materials to consumers. Interest in contract requirements has been more prominent but has been retarded in some cases by the delay of producers in establishing new contract prices.

The weighted index number for the week was 154.85 as compared with 153.90 for the preceding week. The general list of chemicals is holding on a fairly steady basis but higher prices for caustic potash, alcohol, acetate of soda, and linseed oil contributed to bring about a higher average level for the week. Outside of a few commodities which are influenced largely by statistical positions, the price trend appears to be dependent on manufacturing activities with more active trading favorable for an upward swing to values in general.

Advices from Washington state that the Tariff Commission soon will prepare its report on the investigation into linseed oil which was instigated by a petition for a lower duty. While nothing definite can be stated regarding the tenor of the report it is regarded as probable that a reduction in duty will be recommended.

Acids

Fairly steady consuming call is reported for the majority of acids. Reports from sellers of sulphuric acid continue favorable. Stocks at works have been materially reduced and selling pressure has been removed. Contract withdrawals are of large volume and trading in spot and prompt positions has made steady progress. A few producers are sold up for the next ten weeks. Muriatic acid is selling more freely and various consumers are taking on supplies of nitric acid. Moderate demand is noted for U.S.P. phosphoric acid with the 50 per cent variety bringing 15c. per lb., but the technical acid is almost neglected with offerings at 7c. per lb. No improvement is manifest for tartaric acid and the imported material is freely offered at 25½c. per lb. Citric acid also is selling in a small way and the tone of prices is easy. Some sellers of oxalic acid say the market is stronger but 9½c. per lb. can still be done and competition is active enough to prevent any sustained recovery in values. Corroders are proving consistent consumers of acetic acid and demand from other lines also has improved with a steadying effect in quotations. Boric acid is finding a seasonal outlet with no change in asking prices but producers are in keen competition and reports credit sales at concessions.

Denatured Alcohol Marked Up 5c. Per Gal.—Imported Caustic Potash Higher — Epsom Salt Lower for Shipment — Acetate of Soda Firmer — Fusel Oil Steady—Sulphate of Ammonia in Limited Supply —Barium Salts Easy—Caustic Soda Irregular — Nominal Market for Arsenic

Potashes

Bichromate of Potash—Some interest has been shown in 1925 deliveries and some producers are said to have named prices which varied according to the quantities involved. Open quotations of 8¾c. per lb. have been heard for spot and forward deliveries but some business is said to have been placed at 8⅝c. per lb. Spot demand is mainly for moderate sized lots and export inquiry is inactive.

Caustic Potash—The expected advance in shipment prices from Germany went into effect during the past week. Cables quoted prompt and nearby shipment on a basis of 7⅛c. per lb. With producers abroad working together the market appears to be on a steady footing and a recession in price can hardly be looked for. The spot market was advanced, in some quarters, to 7¾c. per lb. but it was possible to buy at 7½c. per lb. Demand was quiet as buyers had anticipated a higher market and had covered requirements before the new prices became effective. The advance in foreign caustic brings domestic material more in line and the latter is offered at 7¼@7½c. per lb. at works.

Chlorate of Potash—Inquiry for spot chlorate is quiet with 7¾c. to 8c. per lb. asked by holders. Recent business for shipment was of good volume and buyers are said to have taken on large lots at 7c. per lb. Arrivals are going direct to consumers and this accounts for the inactivity of the spot market.

Permanganate of Potash—The lower schedule of prices for domestic permanganate, as announced in the preceding week, is still in effect. The market has worked into a position where domestic material is meeting competition of importers and on large lots prices are subject to negotiation with reports that delivered prices are taken into consideration. On less than carlot business asking prices are 12¼@12½c. per lb. at works. Imported permanganate on spot was offered at 12⅛c. per lb.

Prussiate of Potash—Prussiates have been selling only in a small way and with offerings free the market has an easy appearance. Yellow prussiate was quoted at 17c. per lb. on spot but it was intimated that as low as 16½c. per lb. could be done. Shipments from abroad were offered at 16½c. per lb. but buyers were reserved.

Sodas

Acetate of Soda—The reduction in stocks at producing points has had a strengthening effect on values and sellers who were doing business at 4¾c. per lb., in carlots, at works, have advanced their price to 5c. per lb. and the latter now is given as the inside figure. Contract withdrawals are large and some producers have very little to offer for prompt shipment.

Bichromate of Soda — Trading is irregular with some large consuming trades still taking under their normal allotments. Spot material is held at 6¾@7c. per lb. Reports of 1925 contracts are heard and it is stated that considerable business of that nature has been placed in the past two months. Quotations of 6⅝c. per lb. are given by some sellers for next year delivery but some large consumers have covered at lower figures.

Caustic Soda—The market is still in a waiting position with leading producers quoting at former price levels of 3.20c. per lb. for prompt cars, at works. The contract price is still quoted at 3.10c. per lb., at works. There is a

steady movement against old contracts and deliveries are expected to be heavy over the remainder of the year. In fact reports on domestic consumption of caustic have been uniformly favorable and distribution in that direction has partially made up for the loss in export trade. The quotations for export range from 2.80c. to 3c. per lb., f.a.s. There were some offerings for domestic delivery prompt shipment at 2.95c. per lb. and prices for export and for the domestic trade vary according to seller and brand.

Cyanide of Soda—New business is reported as moderate but the tonnage passing to consumers is holding up well and standard makers are quoted as steady at 22c. per lb. Imported cyanides are in fairly large supply with no active call at present. Prices vary according to strength.

Nitrate of Soda—Demand for spot nitrate is quiet and with offerings of fair volume, there has been some competition among sellers and prices of $2.40 per 100 lb. are given as easy with some shading possible. The spot price also holds good for deliveries through December. Total supply of nitrate in sight at the end of September was given as 1,494,000 tons as against 1,415,000 tons for the corresponding period of last year. Production in September was 186,000 tons and shipments 182,000 tons to Europe, 83,000 tons to the United States, and 12,000 tons to other countries.

Miscellaneous Chemicals

Arsenic — Business was virtually at a standstill, insecticide makers showing no buying interest at this time. Prices were quotably unchanged, both on the domestic and imported material, with the undertone rather heavy. Domestic makers were willing to talk business at 7c. per lb., works. Japanese arsenic for immediate delivery was offered down to 6½c. per lb., with European goods at 6¾c. per lb.

Barium Chloride — A little selling pressure was apparent in chloride and prices were easier. During the week there were sellers of spot material at $70@$72 per ton. On shipments from the other side it was possible to do $68 per ton, New York. Carbonate was barely steady, but unchanged at $55 per ton on spot and $53@$54 per ton on futures.

Fusel Oil—Several shipments arrived here in the past week from Europe. Supplies available for immediate delivery have been moderate and with a fair inquiry in evidence prices are holding up well. Crude was held at $2.90@$3.15 per gal., in drums, with refined at $4@$4.50 per gal., according to seller. Amyl acetate was advanced to $3.60@$3.75 per gal.

Epsom Salt—Freer offerings of imported technical salt for shipment from the other side were reported here last week and this resulted in a slightly easier feeling. There were sellers of epsom salt for shipment at $1.30 per 100-lb. The spot market held at $1.35 @$1.40 per 100-lb.

Sulphate of Ammonia—Producers are using their output to take care of existing contracts and have very little surplus for new accounts. Inquiry is not active as consumers are well covered ahead. Bulk sulphate is quoted at $2.60@$2.65 per 100 lb., at works. Export business is at a standstill and f.a.s. quotations are nominal. Production of sulphate of ammonia at byproduct coke plants in 1923 is officially given as reaching a total of 915,926,762 lb.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	154.85
Last week	153.90
Oct., 1923	167.00
Oct., 1922	153.00
Oct., 1921	151.00
Oct., 1920	263.00
Oct., 1919	233.00
Oct., 1918	280.00

The advance of 95 points in the weighted index number reflects higher prices for denatured alcohol, caustic potash and linseed oil.

Alcohol

Small holdings, together with a strong situation in basic materials, brought out another sharp advance in the market for denatured alcohol. Producers announced a higher schedule of prices early in the week, the revised list showing a net gain of 5c. per gal. Special, formula No. 1, is now held at 55c. per gal., in drums, carload basis, with completely denatured, formula No. 5, at 54c. per gal., same basis. Inquiry was good, even after the advance in prices. Ethyl spirits, 190 proof, U.S.P., closed at $4.89 per gal., in bbl.

The market for methanol was nominally unchanged. Demand has not come up to expectations, both in an export and domestic way. On the 97 per cent grade first hands are asking 76c. per gal., in bbl., with the 95 per cent grade at 74c. per gal., in bbl. Pure, tank cars works, held at 76c. per gal.

Coal-Tar Products

Large Stocks of Coke at Byproduct Plants—Benzene Offerings Light and Prices Steady—Foreign Markets Unsettled

THERE was no important change in the production of byproduct coke, operations being restricted because of the inactive condition of the steel industry. This tends to keep down stocks of crude and prices, with but few exceptions, are holding on a comparatively steady basis. The recent decline in gasoline had little influence on the market for benzene, and traders again reported scanty holdings on spot, with prices firm. Sulphate of ammonia is scarce and prices are largely nominal. Prices named on refined naphthalene covered a wide range and, so far as could be learned, very little contract business has been placed this fall. According to the Geological Survey the manufacturers of byproduct coke accumulated stocks of unsold coke during the first 8 months of 1924. On Sept. 1 a group of 21 plants had on hand a total of 1,114,000 tons, an increase of nearly 45 per cent over the stocks held Jan. 1. Foreign markets for coal-tar products were inactive and prices unsettled. Manchester reported offerings of crude naphthalene at £5@£8 per ton, according to quality. Benzene is in moderate supply in the leading English markets, but prices have suffered because of cheaper gasoline. Creosote is available for shipment from works in bulk at 5¼@5½d. per gal.

Beta-naphthol—There was a moderate inquiry for the technical material. The undertone of the market was steady, leading factors quoting 24@26c. per lb., depending upon the quantity and delivery.

Benzene—Official statistics on production of coal-tar products for 1923 reveal that 4,503,428 gal. of crude, 12,364,043 gal. of refined and 80,467,883 gal. of motor benzene were produced in this country. Total production of crude light oil in 1923 amounted to 135,647,175 gal. The market underwent little if any change in the past week. Stocks of 90 per cent and pure benzene are moderate and in firm hands. Leading producers repeated quotations at 23c. per gal. for the 90 per cent grade and 25c. per gal. for the pure, tank cars, f.o.b. works.

Cresylic Acid—Several small shipments of cresylic acid arrived from abroad in the past week. The market was an uninteresting affair, business being restricted to actual nearby wants only. Prices ranged from 58@68c. per gal., in drums, according to grade and seller. Foreign markets were irregular, with the undertone easy.

Naphthalene—Spot prices for refined naphthalene were unsettled and more or less nominal. White flake for immediate delivery was offered at 4¾@5¼c. per lb., according to seller. Some interest was shown in futures, but buyers did not take hold because asking prices were generally above their views. In fact it was possible to buy prompt shipment goods below the level asked on 1925 contracts. In one quarter 5½c. was asked on flaked for whole of 1925 delivery. Total production of naphthalene in the United States in 1923 amounted to 13,011,929 lb. The average price of crude at the works last year was 1.7c. per lb., and of refined 5.5c. per lb.

Phenol—No change occurred in the market, although the undertone appeared firmer in all quarters. Leading sellers again quoted from 24@25c. per lb. in drums, the inside figure obtaining for the large containers, carload basis. There was a fair inquiry for nearby material.

Pyridine — Offerings from abroad were moderate and prices asked firm. The market here was nominally unchanged at $4.25@$4.50 per gal., with a fair inquiry in evidence.

Toluol—Production in 1923 consisted of 37,777 gal. of crude and 2,847,517 gal. of refined toluol. The market closed the week with stocks limited and prices steady on the basis of 26c. per gal., tank cars, f.o.b. works.

Vegetable Oils and Fats

Steady Market for Crude and Refined Cottonseed Oil—Linseed Oil Higher—Tallow and Greases Advance

THE feature in the market was the strength in all of the soap making oils and fats. Round lots of extra special tallow sold at an advance of ½c. per lb., while greases closed fully ¼c. higher. Offerings of palm oil from abroad have virtually dried up and prices heard were higher and more or less nominal. Operations in cottonseed oil were not so extensive, but final quotations on both crude and refined were unchanged to slightly higher than a week ago. The continued strength in lard supported prices. Linseed oil advanced sharply on small offerings of nearby material and higher seed markets in the Northwest. Coconut oil sold at a slight advance in price, reflecting strong conditions in copra at primary centers.

Cottonseed Oil—Selling of refined oil against purchases of crude took on larger proportions, but this did not result in any important price movement. Compared with the prices of a week ago the market for prime summer yellow oil sustained moderate gains. The selling movement was not pronounced and continued strength in pure lard in Chicago caused the speculative element to fight shy of the bear side. Western operators are reported heavily long in the option market on the strength of developments in lard. Late in the week cash lard in Chicago stood at 15.90c. per lb., which compares with 15.25c. a week ago. October prime summer yellow oil settled on Thursday at 10.95@11.20c. per lb., with December at 10.43@10.46c. per lb., and January at 10.47@10.48c. per lb., cooperage basis, Produce Exchange terms. Crude oil sold at 9c. per lb., tank cars, f.o.b. mills, Southeast, and at 8⅞c. per lb., tank cars, f.o.b. mills, Texas. There were buyers at these prices on Thursday. Holdings of seed in the South are large, based on latest ginning figures for cotton, but traders appear to be in no hurry to sell and this tends to maintain prices. Reports on the cotton situation were more favorable and trade authorities believe that pressure to sell should become apparent in another month, notwithstanding the fact that cottonseed oil at this time is the cheapest edible oil of its class on the world's market.

Linseed Oil—Flaxseed markets in the Northwest scored gains of 6@7c. per bu. in the past week. This, coupled with the fact that few crushers were favorably situated in regard to seed supplies for the next month or so, resulted in a strong market for oil. Closing prices for spot oil were fully 5c. per gal. higher for the week, with distant futures up from 5@7c. per gal., depending upon the delivery and seller. Trading in oil was not active. One round lot sold to a linoleum maker, but paint manufacturers held off for the time being. October oil closed at $1.05@$1.06 per gal., with November at $1.01 per gal., and December-April at 99c.@$1 per gal., cooperage basis, carload lots. At the advance interest in foreign oil picked up a little. A report from Washington stated that the Tariff Commission will soon take up the linseed oil tariff case, and it was intimated that a lower duty will be recommended. Unfavorable weather conditions in the Argentine caused much concern regarding next year's supply of seed. Private estimates on the Argentine crop place the outturn at a little over 40,000,000 bu., or 18,000,000 bu. less than the crop harvested in 1923-24. The bullish advices from South America and the active buying of domestic seed by crushers caused prices to advance. Duluth quoted October flaxseed at $2.55, with December at $2.49½. Buenos Aires quoted November seed at $2.20 per bu. Cake for export was in good request and sales took place at $49@$50 per ton, f.a.s. New York.

Argentine Flaxseed Exports to Europe Larger

Demand for Argentine flaxseed for shipment to Europe has been heavy. Exports to the Continent from Jan. 1 to Oct. 10 amounted to 20,774,000 bu., which compares with 12,544,000 bu. for the corresponding period a year ago. General crop conditions in Europe have not been good and this, to a large degree, caused liberal purchases of oilseeds. The demand for oil cake has been active and prices high.

Argentine flaxseed shipments to all countries, from Jan. 1 to Oct. 10, with a comparison, follow:

	1924	1923
United Kingdom, bu....	6,644,000	3,156,000
Continent, bu..........	20,774,000	12,544,000
United States, bu.......	14,239,000	20,556,000
On orders, bu..........	8,294,000	5,176,000
Total................	49,951,000	41,432,000

China Wood Oil—Demand was inactive and prices were slightly lower. Spot oil was available at 15⅞c. with nearby futures at 15¼c. per lb., in bbl. On the Pacific coast there were offerings of tank cars for shipment at 14¼c. per lb.

Corn Oil—Crude oil sold at 9⅞@10c. per lb., tank cars, f.o.b. Chicago. Offerings of prompt oil were light and the market firm.

Coconut Oil—Not much business came to light, but the few sales that went through revealed a moderately higher trading basis. Copra for shipment from Manila was strong, advancing to 5½@5⅝c. per lb., c.i.f., Pacific coast ports. The advance in copra made sellers of oil more reserved. In New York Ceylon type oil settled at 10c. asked, tank car basis. On the Pacific coast December forward oil sold at 9c. per lb., tank car basis, with prompt oil firm at 9¼c. per lb.

Palm Oils—Niger oil for November-December-January shipment from Africa sold at 8¼c. per lb., c.i.f. New York. Lagos oil was entirely nominal at 8⅞c. per lb., forward delivery. Offerings were scanty and prices named by importers were not based on firm offers. Because of the advance in tallow inquiry from soap makers was more in evidence.

Rapeseed Oil—English refined oil sold on spot at 3c. per gal. On futures importers held out for 94c. per gal. Demand quiet.

Sesame Oil—Refined oil was traded in at 12½@13c. per lb., in bbl., immediate delivery.

Fish Oils—There was no improvement in fishing operations and the market for crude menhaden oil held firm at 52½c. per gal., tank cars, factory, the last trading basis. Untanked Newfoundland cod oil was offered for shipment from St. Johns at 58c. per gal., in bbl.

Tallow, Etc.—More than 500,000 lb. of extra special tallow sold at 9¼c. per lb., an advance of ½c. for the week. There were buyers at this price at the close, with holders generally asking 9½c. Yellow grease was raised to 8@8¼c. per lb. Oleo stearine sold at 13½c. per lb. No. 1 oleo oil sold for export at 21¾c. per lb.

Miscellaneous Materials

Antimony — Arrivals of antimony regulus are larger than in some time past. The market for the metal was firm, in sympathy with the Chinese situation, and quotations were repeated at 11@11¼c. per lb. Cookson's "C" grade was advanced to 14¼@14½c. per lb. Chinese needle, lump, nominal at 8½@9c. per lb. Powdered needle, 200 mesh, 9@10c. per lb. White oxide, Chinese, 12@13c. per lb.

Glycerine — Dynamite sold at 18¼c. per lb., in drums, carload lots, f.o.b. point of production in the Middle West, indicating that the market underwent no change in the past week. Chemically pure glycerine in the New York trade held at 19c. per lb., drums included. Crude, soap lye, basis 80 per cent, nominal at 12@12¼c. per lb., loose, carload lots, f.o.b. point of production.

Naval Stores—The feature in the market was the strength in rosin, all grades closing from 15@25c. per bbl. higher. On the lower grades dealers now quote $6.90@$7.10 per bbl. Turpentine was inactive and barely steady, business passing at 87@88c. per gal. in bbl.

White Lead—There was not enough change in the market for pig lead to cause corroders to change their selling views on lead pigments. Business was described as normal for this time of the year and a rather steady undertone prevailed in all quarters. Standard dry white lead, in bbl. or casks, held at 10c. per lb., carload lots.

Zinc Oxide—The market was higher on zinc, but no change occurred in oxide. Producers expect contract business to open up shortly. American process zinc oxide held at 7⅝c. per lb.

Imports at the Port of New York

October 10 to October 16

ACIDS—Cresylic—23 dr., Manchester, De Mattia Chemical Co., Inc.; 12 dr., Liverpool, Order. **Benzoic**—3 cs., London, H. J. Baker & Bro. **Formic**—80 dr., Rotterdam, Roessler & Hasslacher Chem. Co.; 150 dem., Rotterdam, R. W. Greeff & Co. **Oxalic** —35 csk., Rotterdam, Superfos Co. **Stearic** —20 cs., Rotterdam, M. W. Parsons & Plymouth Organic Lab.

ALBUMEN—56 cs., Shanghai, A. Klipstein & Co.; 55 cs., Shanghai, Habicht, Braun & Co.; 31 cs., Tientsin, Stein, Hall & Co.; 56 cs., Tientsin, F. A. Cundill & Co.

AMMONIUM CHLORIDE—26 csk., Rotterdam, Goldschmidt Corp.

AMMONIUM CARBONATE — 20 csk., London, C. B. Richard & Co.

ANTIMONY REGULUS—500 cs., Shanghai, Wah Chang Trading Corp.; 250 cs., Shanghai, American Trading Co.; 250 cs., Shanghai, Wah Chang Trading Co.; 500 cs., Shanghai, Suzuki & Co.

ANTIMONY SULPHIDE—14 csk., London, Order; 7 csk., London, L. H. Butcher & Co.

ARSENIC—92 bbl., Tampico, American Metal Co.

ASBESTOS—200,100 lb. crude, Beira, W. D. Crumpton & Co.

BARIUM PEROXIDE—148 kegs, Rotterdam, W. A. Brown & Co.

BARYTES—60 csk., Rotterdam, Schall Color & Chemical Co.; 600 bg., Rotterdam, E. L. Bullock & Sons.

BONE FLOUR — 400 bg., London, De Mattia Chemical Co., Inc.

BRONZE POWDER—5 cs., Bremen, B. F. Drakenfeld & Co.; 10 pkg., Bremen, American Express Co.

CALCIUM CHLORIDE—154 dr., Rotterdam, E. Suter & Co.

CALCIUM NITRATE—61 csk., Rotterdam, Kuttroff, Pickhardt & Co.

CAMPHOR—200 cs., Shanghai, Suzuki & Co.; 40 cs., Canton, L. C. Hopkins Co.; 30 cs. crude, Keelung, J. W. Hampton Co.; 270 cs. do., Keelung, Fiberloid Corp.

CASEIN—500 bg., Buenos Aires, Kalbfleisch Corp.

CHALK—264,000 kilos crude, Dunkirk, Taintor Trading Co.; 800,000 kilos, Dunkirk, J. W. Higman Co.; 4,638 bg., Antwerp, National City Bank; 800 bg., Antwerp, Brown Bros. & Co.; 275 bg., Bristol, H. J. Baker & Bro.; 500 tons, London, Baring Bros. & Co.

CHEMICALS—17 bbl., Bremen, Stanley Doggett & Co.; 274 bg., Glasgow, Brown Bros. & Co.; 9 bg., Glasgow, De Mattia Chemical Co.; 330 bg., Glasgow, Order; 32 bbl., Hamburg, Merck & Co.; 330 bg., Glasgow, Brown Bros. & Co.; 4 pkg., Hamburg, Eimer & Amend; 100 csk., Rotterdam, Hans Hinrichs Chemical Corp.; 22 cs., Rotterdam, Alpers & Mott; 48 csk., Rotterdam, Roessler & Hasslacher Chemical Co.; 20 cs., Rotterdam, H. A. Metz & Co.; 200 cs., Southampton, Lehn & Fink; 87 csk., London, Toch Bros.

CHINA CLAY — 335 bg., Bristol, National City Bank; 267 bg., Bristol, C. T. Wilson & Co.; 55 tons, Bristol, J. W. Hampton & Co.; 300 tons, Bristol, Hammill & Gillespie; 317 tons, Bristol, Moore & Munger; 3,488 tons, Fowey, Moore & Munger; 3,824 tons, Fowey, English China Clay Sales Co.

COBALT OXIDE — 2 cs., Antwerp, Schenkers, Inc.

COLORS—8 csk., Southampton, American Exchange National Bank; 31 csk. aniline, Havre, American Exchange National Bank; 6 pkg. do., Hamburg, Franklin Import & Export Co.; 17 csk. umber, Manchester, L. H. Butcher Co.; 5 csk. aniline, Genoa, Banca Comm. Italo; 11 pkg., Antwerp, American Exchange National Bank; 4 bbl. aniline, Antwerp, H. A. Metz & Co.; 3 bbl., Antwerp, Irving Bank & Col. Trust Co.; 20 cs. ultramarine blue, Antwerp, American & Cuban S. S. Co.; 16 cs. aniline, Havre, Sandoz Chemical Works; 30 csk. do., Havre, Reichard-Coulston, Inc.; 8 csk. do., Havre, Carbic Color & Chem. Co.; 31 cs. do., Havre, Ciba Co.; 3 csk. do., Havre, Geigy Co.; 15 csk., Havre, Order; 14 csk. ultramarine blue, Glasgow, A. Maharrie; 2 csk. aniline, Hamburg, Kuttroff, Pickhardt & Co.; 24 pkg. do., Rotterdam, Grasselli Dyestuff Corp.; 40 csk. do., Rotterdam, Kuttroff, Packhardt & Co.; 68 csk. earth, Rotterdam, Reichard-Coulston, Inc.

COPPER SULPHATE — 100 bbl., Antwerp, H. Falck & Co.

CORUNDUM ORE—1,556 bg., Delagoa Bay, Standard Bank of South Africa; 98 bg., Delagoa Bay, Order.

CREOSOTE OIL — 6 dr., Glasgow, Order.

CREAM TARTAR—100 csk., Rotterdam, Order.

DIVI-DIVI — 131 bg., Monte Christi, Schmoll & Co.

EPSOM SALT — 300 bg., Hamburg, Brown Bros. & Co.; 500 bg., Hamburg, Innis, Speiden & Co.

FUSEL OIL—15 bbl., Rotterdam, East River National Bank; 41 dr., Antwerp, Order.

Opportunities in the Foreign Trade

Parties interested in any of the following opportunities may obtain all available information from the Bureau of Foreign and Domestic Commerce at Washington or from any district office of the bureau. The number placed after the opportunity must be given for the purpose of identification.

FERTILIZERS. Fort-de-France, Martinique. Agency.—11,881.

COTTONSEED OIL. Fort-de-France, Martinique. Agency.—11,881.

OILS, palm, coconut, castor and their substitutes. Lille, France. Purchase.—11,869.

FATS AND OILS. Amsterdam, Netherlands. Purchase.—11,863.

LINSEED CAKE. Amsterdam, Netherlands. Purchase.—11,863.

FULLERS EARTH—350 bg., London, L. A. Salomon & Bros.

GALLNUTS—112 cs., Shanghai, Zinsser & Co.

GLYCERINE — 20 csk., Bordeaux, Order; 100 dr. crude, Rotterdam, Order.

GRAPHITE — 375 bg., Kobe, Mitsui & Co.; 39 csk., Moji, Order.

GUMS—280 pkg. copal, Manila, Chartered Bank of India, Australia & China; 37 cs. benjamin, Singapore, National City Bank; 41 bg. copal, Antwerp, R. F. Darrell Co.; 69 bg. do., Antwerp, Chemical National Bank; 12 bg. copal, London, S. Winterbourne & Co.

IRON OXIDE—160 bg., Bristol, G. Z. Collins & Co.; 67 csk., Bristol, Reichard-Coulston, Inc.; 55 csk., Liverpool, Reichard-Coulston, Inc.; 47 csk., Liverpool, J. Lee Smith & Co.; 10 csk., Liverpool, Order.

LITHOPONE—40 csk., Rotterdam, L. H. Butcher Co.

MAGNESITE—110 bbl. and 255 bg., Rotterdam, Brown Bros. & Co.

MAGNESIUM CHLORIDE — 546 dr., Hamburg, Innis, Speiden & Co.

MANGANESE ORE—101,500 kilos, Rotterdam, Iron & Ore Chemical Co.

NAPHTHALENE — 1 csk., Hamburg, Lehn & Fink.

OILS—Cod—53 csk. and 16 half csk., Halifax, Cook & Swan Co.; 250 csk., St. Johns, National Oil Products Co.; 25 csk., St. Johns, R. Babcock & Co.; 100 csk., St. Johns, Cook & Swan Co.; 400 csk., St. Johns, Franklin Agency; 200 csk., St. Johns, Order; 294 tons, St. Johns, Cook & Swan Co. **China Wood**—146 bbl., Shanghai, Cook & Swan Co.; 225 bbl., Shanghai, Mitsui & Co.; 143 bbl., Shanghai, G. W. S. Patterson & Co.; 300 bbl., Hankow, Japan Cotton Trading Co.; 210 csk., Hankow, Order. **Coconut**—800 tons (in bulk), Manila, Spencer Kellogg & Sons. **Castor**—100 bbl., Kobe, Mitsui & Co. **Linseed**—97 dr., Rotterdam, Order. **Olive foots** (sulphur oil)—200 csk., Leghorn, Leghorn Trading Co.; 196 bbl., Piraeus, Bank of Athens. **Palm**—652 csk., Hamburg, African & Eastern Trading Co. **Rapeseed**—10 csk., Havre, F. B. Vandegrift & Co. **Sesame**—200 bbl., Rotterdam, Lockwood & Co.

OIL SEEDS—Copra—4,200 tons (at San Francisco), Manila, Order; 3,000 tons (at San Francisco), Manila, Order.

PITCH—40 bbl. stearine, Rotterdam, Elbert & Co.

PLUMBAGO — 180 bbl., Colombo, National City Bank; 928 bg., Colombo, Order.

POTASSIUM SALTS—4000 bg. sulphate and 50 bbl. do., Bremen, Potash Importing Corp. of America; 4000 bg. sulphate, Bremen, Potash Importing Corp. of America; 6000 bg. sulphate, Hamburg, Potash Importing Corp. of America; 4000 bg. sulphate and 1 lot (in bulk) manure salt, Hamburg, Potash Importing Corp. of America; 850 csk. chlorate, Hamburg, Seaboard National Bank; 75 csk. bicarbonate, Rotterdam, Meteor Products Co.; 20 csk. prussiate, Rotterdam, East River National Bank; 53 bbl. alum, Rotterdam, Hans Hinrichs Chemical Co.; 207 csk. alum, Rotterdam, A. Klipstein & Co.; 375 dr., caustic, Hamburg, A. Klipstein & Co.; 90 csk. per chlorate, Antwerp, H. Schroeder Corp.; 18 bbl. prussiate, Antwerp, E. Suter & Co.; 250 bg. nitrate, Antwerp, Order.

PYRIDINE—6 dr., London, Order.

QUEBRACHO—19,660 bg. Buenos Aires, Tannin Corp.

QUICKSILVER—40 flasks, Vera Cruz, Poillon & Poirier; 50 flasks, London, H. W. Peabody & Co.; 50 flasks, London, Pickering & Co.; 50 flasks, London, Order.

ROSIN—30 bbl., Piraeus, Order.

SAL AMMONIAC—140 csk., Rotterdam, Kuttroff, Pickhardt & Co.; 34 csk., Rotterdam Seaboard National Bank.

SHELLAC—225 bg., Calcutta, Brown Bros & Co.; 391 Bg., Calcutta, Standard Bank of South Africa; 600 bg. Calcutta, Marx & Rawolle; 100 bg. Calcutta, Bank of London & South America; 2150 bg., Calcutta, Order; 75 pkg., Hamburg, Rogers, Pyatt Shellac Co.; 84 cs., Singapore, Order; 175 bg., Hamburg, Ralli Bros.; 31 cs., Rotterdam, C. P. Gerlach; 100 bg., London, Order.

SODIUM SALTS—224 cs. cyanide, Havre, International Banking Corp.; 23 csk. prussiate, Rotterdam, Meteor Products Co.; 200 csk. fluoride, Rotterdam, E. Suter & Co.; 9 cs. peroxide, Rotterdam, F. E. Wallace; 18 csk. prussiate, Liverpool, Meteor Products Co.; 224 cs. cyanide, Liverpool, Order; 200 bbl. chlorate, Antwerp, E. Suter & Co.

STARCH—850 bg. potato, Rotterdam, Stein, Hall & Co.; 250 bg. do., Rotterdam, Order.

SULPHUR—200 csk., Bordeaux, Heemsoth, Basse & Co.

TALC—200 bg., Genoa, J. H. Furman Co.

TARTAR—143 bg., Lisbon, Tartar Chemical Works; 107 bg., Lisbon, Order.

VERMILION—20 kegs, London, Pomeroy & Fischer.

WAXES—11 bg. beeswax, Azua, Yglesias & Co.; 14 bg. do., Santo Domingo, Curacao Trading Co.; 27 bg. do., Sanchez, Yglesias & Co.; 7 bl. do., Puerto Plata, Cordillera Comm. Co.; 5 pkg. do., Monte Cristi, Porcella, Vicini & Co.; 85 bg. beeswax, Rio de Janeiro, American Trading Co.; 67 bg. beeswax, Lisbon, National City Bank; 300 bg. montan, Hamburg, National Bank of Commerce; 375 bg. do., Hamburg, Strohmeyer & Arpe Co.

WHITING—2000 bg., Havre, Hammill & Gillespie; 500 bg., Antwerp, Reichard-Coulston, Inc.

WOOL GREASE—10 bbl., Bremen, Order; 140 bbl., Antwerp, Order.

ZINC CHLORIDE—136 csk., Rotterdam, Goldschmidt Corp.

ZINC DUST—100 cs., Kobe, Mitsue & Co.

ZINC OXIDE—50 bbl., Genoa, Order; 10 cs., London, C. Huisking & Co.

ZINC SULPHIDE—2 csk., London, C. A. Sykes.

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

Industrial Chemicals

Acetone, drums, works	lb.	$0.16 –	$0.16½
Acetic anhydride, 85 %, dr	lb.	.34 –	.36
Acid, acetic, 28%, bbl.	100 lb.	3.12 –	3.37
Acetic, 56%, bbl.	100 lb.	5.85 –	6.10
Acetic, 80%, bbl.	100 lb.	8.19 –	8.44
Glacial, 99½%, bbl.	100 lb.	11.01 –	11.51
Boric, bbl.	lb.	.09 –	.09½
Citric, kegs	lb.	.45½–	.46½
Formic, 85%	lb.	.11½–	.11¾
Gallic, tech.	lb.	.45½–	.47
Hydrofluoric, 52%, carboys	lb.	.11 –	.12
Lactic, 44%, tech., light, bbl.	lb.	.12½–	.13
22% tech., light, bbl.	lb.	.06 –	.06½
Muriatic, 18° tanks	100 lb.	.80 –	.85
Muriatic, 20°, tanks	100 lb.	.95 –	1.00
Nitric, 36°, carboys	lb.	.04 –	.04½
Nitric, 42°, carboys	lb.	.04¾–	.05½
Oleum, 20%, tanks	ton	16.00 –	17.00
Oxalic, crystals, bbl.	lb.	.09½–	.09¾
Phosphoric, 50% carboys	lb.	.07 –	.08
Pyrogallic, resublimed	lb.	1.55 –	1.60
Sulphuric, 60°, tanks	ton	8.00 –	9.00
Sulphuric, 60°, drums	ton	12.00 –	13.00
Sulphuric, 66°, tanks	ton	13.00 –	14.00
Sulphuric, 66°, drums	ton	17.00 –	18.00
Tannic, U.S.P., bbl.	lb.	.65 –	.70
Tannic, tech., bbl	lb.	.45 –	.50
Tartaric, imp., powd., bbl.	lb.	.26½–	.28
Tartaric, domestic, bbl.	lb.	.29 –	.30
Tungstic, per lb.	lb.	1.20 –	1.25
Alcohol, butyl, drums, wks.	lb.	.30 –	.....
Ethyl, 190 p'f. U.S.P., bbl.	gal.	4.89 –	.....
Denatured, 190 proof No. 1, special bbl.	gal.	.61 –	.....
No. 1, 190 proof, special, dr.	gal.	.55 –	.....
No. 1, 188 proof, bbl.	gal.	.65 –	.....
No. 1, 188 proof, dr.	gal.	.58 –	.....
No. 5, 188 proof, bbl.	gal.	.60 –	.....
No. 5, 188 proof, dr.	gal.	.55 –	.....
Alum, ammonia, lump, bbl.	lb.	.03½–	.04
Potash, lump, bbl.	lb.	.02¾–	.03½
Chrome, lump, potash, bbl.	lb.	.05½–	.06
Aluminum sulphate, com., bags	100 lb.	1.35 –	1.40
Iron free, bags	lb.	2.35 –	2.45
Aqua ammonia, 26°, drums	lb.	.06½–	.06¾
Ammonia, anhydrous, cyl.	lb.	.28 –	.30
Ammonium carbonate, powd. tech., casks	lb.	.12½–	.12¾
Nitrate, tech., casks	lb.	.09 –	.10
Amyl acetate tech., drums	gal.	3.60 –	3.75
Antimony oxide, white, bbl.	lb.	.12 –	.12½
Arsenic, white, powd., bbl.	lb.	.06½–	.07
Red, powd., kegs	lb.	.14¾–	.15½
Barium carbonate, bbl.	ton	55.00 –	57.00
Chloride, bbl.	ton	70.00 –	72.00
Dioxide, 88%, drums	lb.	.17½–	.18
Nitrate, casks	...	.07½–	.08
Blanc fixe, dry, bbl.	lb.	.03¾–	.04
Bleaching powder, f.o.b. wks., drums	100 lb.	1.90 –	.....
Spot N. Y. drums	100 lb.	2.20 –	2.25
Borax, bbl.	lb.	.05 –	.05½
Bromine, cases	lb.	.34 –	.38
Calcium acetate, bags	100 lb.	3.00 –	3.05
Arsenate, dr.	lb.	.08 –	.08½
Carbide, drums	lb.	.05 –	.05½
Chloride, fused, dr. wks.	ton	21.00 –	.....
Gran. drums works	ton	27.00 –	.....
Phosphate, mono, bbl.	lb.	.06¾–	.07½
Carbon bisulphide, drums	lb.	.06 –	.06½
Tetrachloride, drums	lb.	.06½–	.07
Chalk, precip.—domestic, light, bbl.	lb.	.04½–	.04½
Imported, light, bbl.	lb.	.04½–	.05
Chlorine, liquid, tanks, wks.	lb.	.04½–	.....
Contract, tanks, wks.	lb.	.04½–	.....
Cylinders, 100 lb., wks.	lb.	.05½–	.07½
Cobalt, oxide, bbl.	lb.	2.10 –	2.25
Copperas, bulk, f.o.b. wks.	ton	15.00 –	16.00
Copper carbonate, bbl.	lb.	.17 –	.17½
Cyanide, drums	lb.	.49 –	.50
Oxide, kegs	lb.	.16 –	.16½
Sulphate, dom., bbl.	100 lb.	4.40 –	4.65
Imp. bbl.	100 lb.	4.37½–	.....
Cream of tartar, bbl.	lb.	.20½–	.21
Epsom salt, dom., bbl.	100 lb.	1.75 –	2.00
Imp., tech., bags	100 lb.	1.35 –	1.40
U.S.P., dom., bbl.	100 lb.	2.10 –	2.35
Ether, U.S.P., dr concent'd.	lb.	.13 –	.14
Ethyl acetate, 85%, drums	gal.	.92 –	.95
Acetate, 99%, dr.	gal.	1.08 –	1.10
Formaldehyde, 40%, bbl.	lb.	.09 –	.09½
Fullers earth—f.o.b. mines	ton	7.50 –	18.00
Furfural, works, bbl.	lb.	.25 –	.....
Fusel oil, ref., drums	gal.	4.00 –	4.50
Crude, drums	gal.	3.00 –	3.10
Glaubers salt, wks., bags	100 lb.	1.20 –	1.40
Imp., bags	100 lb.	.90 –	.92
Glycerine, c. p., drums extra	lb.	.19 –	.19½
Crude 80%, loose	lb.	.12 –	.12½
Hexamethylene, drums	lb.	.65 –	.70

THESE prices are first-hand quotations in the New York market for industrial chemicals, coal-tar products and related materials used in the industries that produce

Dyes	**Paper and Pulp**
Paint and Varnish	**Petroleum**
Ceramic Materials	**Soap**
Fertilizers	**Explosives**
Rubber	**Food Products**
Sugar	**Metal Products**

Whenever available these prices are those of the American manufacturer. If for material f.o.b. works or on a contract basis, quotations are so designated. All prices refer to large quantities in original packages.

Lead:			
White basic carbonate, dry, casks	lb.	$0.10 –	.....
White, basic sulphate, casks	lb.	.09½–	.....
White, in oil, kegs	lb.	.11¼–	.....
Red, dry, casks	lb.	.11 –	.....
Red, in oil, kegs	lb.	.13½–	$0.13¾
Acetate, white crys., bbl.	lb.	.14½–	.....
Brown, broken, casks	lb.	.13½–	.....
Arsenate, white crys., bbl.	lb.	.16 –	.18
Lime-Hydrated, b.g., wks.	ton	10.50 –	12.50
Bbl., wks.	ton	18.00 –	19.00
Lump, bbl.	280 lb.	3.63 –	3.65
Litharge, comm., casks	lb.	.10½–	.....
Lithopone, bags	lb.	.06 –	.06½
Magnesium carb., tech., bags	lb.	.08½–	.08½
Methanol, 95%, bbl.	gal.	.74 –	.76
97%, bbl.	gal.	.76 –	.79
Pure, tanks	gal.	.76 –	.....
drums	gal.	.78 –	.80
bbl.	gal.	.83 –	.85
Methyl-acetone, t'ks.	gal.	.70 –	.....
Nickel salt, double, bbl.	lb.	.09½–	.10
Single, bbl.	lb.	.10 –	.11
Orange mineral, csk.	lb.	.14 –	.14½
Phosgene	...	.60 –	.75
Phosphorus, red, cases	lb.	.70 –	.75
Yellow, cases	lb.	.37½–	.40
Potassium bichromate, casks	lb.	.08½–	.08¾
Bromide, gran., bbl.	lb.	.34 –	.38
Carbonate, 80-85%, calcined, casks	lb.	.05 –	.06½
Chlorate, powd.	lb.	.06½–	.08½
Cyanide, drums	lb.	.47 –	.52
First sorts, cask	lb.	.08½–	.08½
Hydroxide (caustic potash) drums	lb.	.07½–	.07½
Iodide, cases	lb.	3.65 –	3.75
Nitrate, bbl.	lb.	.06 –	.07½
Permanganate, drums	lb.	.12½–	.12¾
Prussiate, red, casks	lb.	.37 –	.38
Prussiate, yellow, casks	lb.	.16½–	.17
Salammoniac, white, gran., casks, imported	lb.	.06 –	.06½
White, gran., bbl., domestic	lb.	.07½–	.08
Gray, gran., casks	lb.	.08 –	.09
Salsoda, bbl.	100 lb.	1.20 –	1.40
Salt cake (bulk) works	ton	16.00 –	17.00
Soda ash, light 58% flat, bulk, contract	100 lb.	1.25 –	.....
bags, contract	100 lb.	1.38 –	.....
Dense, bulk, contract, basis 58%	100 lb.	1.35 –	.....
bags, contract	100 lb.	1.45 –	.....
Soda, caustic, 76%, solid, drums contract	100 lb.	3.10 –	.....
Caustic, ground and flake, contracts, dr.	100 lb.	3.50 –	3.85
Caustic, solid, 76% f.a.s. N. Y.	100 lb.	2.85 –	3.05
Sodium acetate, works, bbl.	lb.	.04½–	.05
Bicarbonate, bulk	100 lb.	1.75 –	.....
Bichromate, casks	lb.	.06½–	.07
Bisulphate (niter cake)	ton	6.00 –	7.00
Bisulphite, powd., U.S.P., bbl.	lb.	.04½–	.04½
Chlorate, kegs	lb.	.06½–	.06½
Chloride	long ton	12.00 –	13.00
Cyanide, cases	lb.	.19 –	.22
Flouride, bbl.	lb.	.08½–	.09
Hyposulphite, bbl.	lb.	.02½–	.02½
Nitrite, casks	lb.	.09½–	.09½
Peroxide, powd., cases	lb.	.23 –	.27
Phosphate, dibasic, bbl.	lb.	.03½–	.03½
Prussiate, yel. bbl.	lb.	.09½–	.09½

Salicylate, drums	lb.	$0.38 –	$0.40
Silicate (40°, drums)	100 lb.	.75 –	1.16
Silicate (60°, drums)	100 lb.	1.75 –	2.00
Sulphide, fused, 60-62%, drums	lb.	.02½–	.03½
Sulphite, crys., bbl.	lb.	.02 –	.02½
Strontium nitrate, powd., bbl	lb.	.09 –	.09½
Sulphur chloride, yel drums	lb.	.04½–	.05
Crude	ton	18.00 –	20.00
At mine, bulk	ton	16.00 –	18.00
Flour, bag	100 lb.	2.25 –	2.35
Dioxide, liquid, cyl.	lb.	.08 –	.08½
Tin bichloride, bbl.	lb.	.13½–	.....
Oxide, bbl.	lb.	.52 –	.....
Crystals, bbl.	lb.	.35 –	.....
Zinc carbonate, bags	lb.	.12 –	.14
Chloride, gran., bbl.	lb.	.06 –	.07½
Cyanide, drums	lb.	.40 –	.41
Dust bbl.	lb.	.08 –	.08½
Oxide, lead free, bag	lb.	.07½–	.....
5% lead sulphate bags	lb.	.06½–	.....
French, red seal, bags	lb.	.09½–	.....
French, green seal, bags	lb.	.10½–	.....
French, white seal, bbl.	lb.	.11½–	.....
Sulphate, bbl.	100 lb.	3.00 –	3.25

Coal-Tar Products

Alpha-naphthol, crude, bbl.	lb.	$0.62 –	$0.65
Alpha-naphthol, ref., bbl.	lb.	.65 –	.75
Alpha-naphthylamine, bbl.	lb.	.35 –	.36
Aniline oil, drums	lb.	.16 –	.16½
Aniline salt, bbl.	lb.	.19 –	.21
Anthracene, 80%, drums	lb.	.70 –	.75
Anthraquinone, 25%, drums	lb.	.75 –	.80
Benzaldehyde U.S.P., tech., drums	lb.	.70 –	.72
Benzene, pure, tanks, works	gal.	.25 –	.....
Benzene, 90%, tanks, works	gal.	.23 –	.....
Benzidine base, bbl.	lb.	.80 –	.81
Benzyl chloride, ref. carboys	lb.	.35 –	.....
Benzyl chloride, tech., drums	lb.	.25 –	.....
Beta-naphthol, tech., bbl.	lb.	.24 –	.25
Beta-naphthylamine, tech.	lb.	.65 –	.70
Cresylic acid, 97%, drums	gal.	.63 –	.65
95-97%, drums, works	gal.	.58 –	.60
Dichlorbenzene, drums	lb.	.07 –	.08
Dinitrobenzene, bbl.	lb.	.15 –	.17
Dinitrochlorbenzene, bbl.	lb.	.21 –	.22
Dinitrophenol, bbl.	lb.	.35 –	.40
Dinitrotoluen, bbl.	lb.	.18 –	.20
Dip oil, 25%, drums	gal.	.26 –	.28
H-acid, bbl.	lb.	.72 –	.75
Meta-phenylenediamine, bbl.	lb.	.90 –	.95
Monochlorbenzene, drums	lb.	.08 –	.10
Naphthalene, flake, bbl.	lb.	.04½–	.05½
Naphthionate of soda, bbl.	lb.	.60 –	.65
Naphthionic acid, crude, bbl.	lb.	.60 –	.62½
Nitrobenzene, drums	lb.	.09 –	.09
Nitro-naphthalene, bbl.	lb.	.25 –	.27
Nitro-toluene, drums	lb.	.13½–	.14
N-W acid, bbl.	lb.	1.00 –	1.05
Ortho-amidophenol, kegs	lb.	2.40 –	2.50
Ortho-dichlorbenzene, drums	lb.	.10 –	.11
Ortho-toluidine, bbl.	lb.	.14 –	.16
Para-aminophenol, base, kegs	lb.	1.15 –	1.20
Para-dichlorbenzene, bbl.	lb.	.17 –	.20
Para-nitraniline, bbl.	lb.	.68 –	.70
Para-nitrotoluene, bbl.	lb.	.50 –	.55
Para-phenylendiamine, bbl.	lb.	1.35 –	1.45
Para-toluidine, bbl.	lb.	.75 –	.80
Phenol, U.S.P., dr.	lb.	.24 –	.26
Picric acid, bbl.	lb.	.20 –	.22
Pitch, tanks, works	ton	27.00 –	30.00
Pyridine, imp., drums	gal.	4.25 –	4.35
Resorcinol, tech., kegs	lb.	1.30 –	1.40
Resorcinol, pure, kegs	lb.	2.00 –	2.25
R-salt, bbl.	lb.	.50 –	.55
Salicylic acid, tech., bbl.	lb.	.32 –	.33
Salicylic acid, U.S.P., bbl.	lb.	.35 –	.....
Solvent naphtha, water-white, tanks	gal.	.24 –	.25
Crude, tanks	gal.	.21 –	.22
Sulphanilic acid, crude, bbl.	lb.	.16 –	.18
Tolidine, bbl.	lb.	1.00 –	1.05
Toluidine, mixed, kegs	lb.	.30 –	.35
Toluene, tank cars, works	gal.	.26 –	.....
Toluene, drums, works	gal.	.31 –	.....
Xylidine, drums	lb.	.40 –	.42
Xylene, 5 deg.-tanks	gal.	.38 –	.40
Xylene, com., tanks	gal.	.25 –	.27

Naval Stores

Rosin B-D, bbl.	280 lb.	$6.90 –	$7.00
Rosin E-I, bbl.	280 lb.	6.90 –	7.00
Rosin K-N, bbl.	280 lb.	7.00 –	7.10
Rosin W.G.-W.W., bbl.	280 lb.	7.90 –	8.50
Turpentine, spirits of, bbl.	gal.	.87 –	.88
Wood, steam dist., bbl.	gal.	.74 –	.75
Wood, dest. dist., bbl.	gal.	.55 –	.56
Pine tar pitch, bbl.	200 lb.	5.50 –	.....
Tar, kiln burned, bbl.	500 lb.	10.50 –	.....
Rosin oil, first run, bbl.	gal.	.42 –	.....
Pine tar oil, com'l.	gal.	.30 –	.....

Animal Oils and Fats

Degras, bbl.	lb.	$0.03½ – $0.05½
Grease, yellow, loose	lb.	.08 – .08¼
Lard oil, Extra No. 1, bbl.	gal.	.86 – .88
Lard compound, bbl.	lb.	.13½ – .13¾
Neatsfootoil, 20 deg. bbl.	gal.	1.35 – .....
Oleo Stearine	...	.13½ – .....
Oleo oil, No. 1, bbl.	lb.	.20¾ – .21½
Red oil, distilled, d.p. bbl.	lb.	.09¼ – .09½
Tallow, extra, loose works	lb.	.09¼ – .09½
Tallow oil, acidless, bbl.	gal.	.86 – .87

Vegetable Oils

Castor oil, No. 3, bbl.	lb.	$0.16½ – $0.06¾
Castor oil, No. 1, bbl.	lb.	.16¾ – .17
Chinawood oil, bbl.	lb.	.15½ – .16
Coconut oil, Ceylon, bbl.	lb.	.10½ – .10¾
Ceylon, tanks, N. Y.	lb.	.09¾ – .10
Corn oil, crude, bbl.	lb.	.11¼ – .11½
Crude, tanks, (f.o.b. mill)	lb.	.10 – .....
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.08¾ – .09
Summer yellow, bbl.	lb.	.11½ – .....
Linseed oil, raw, car lots, bbl.	gal.	1.05 – .....
Raw, tank cars (dom.)	gal.	.99 – .....
Boiled, cars, bbl. (dom.)	gal.	1.07 – .....
Olive oil, denatured, bbl.	gal.	1.18 – 1.22
Sulphur, (foots) bbl.	lb.	.09¼ – .09½
Palm, Lagos, casks	lb.	.08¾ – .09
Niger, casks	lb.	.08¾ – .....
Palm kernel, bbl.	lb.	.10 – .....
Peanut oil, crude, tanks (mill)	lb.	.12½ – .....
Refined, bbl.	lb.	.16 – .16½
Perilla, bbl.	lb.	.14 – .14½
Rapeseed oil, refined, bbl.	gal.	.93 – .94
Sesame, bbl.	lb.	.12¾ – .13½
Soya bean (Manchurian), bbl	lb.	.12 – .12¼
Tank, f.o.b. Pacific Coast	lb.	.10¾ – .10¾

Fish Oils

Cod, Newfoundland, bbl.	gal.	$0.62 – $0.65
Menhaden, light pressed, bbl.	gal.	.64 – .....
White bleached, bbl	gal.	.66 – .....
Crude, tanks (f.o.b. factory)	gal.	.52½ – .....
Whale No. 1 crude, tanks, coast	lb.	..... – .....
Winter, natural, bbl.	gal.	.75 – .76
Winter, bleached, bbl.	gal.	.78 – .79

Dye & Tanning Materials

Albumen, blood, bbl.	lb.	$0.50 – $0.55
Albumen, egg, tech, kegs	lb.	.95 – .97
Cochineal, bags	lb.	.33 – .35
Cutch, Borneo, bales	lb.	.04½ – .04¾
Rangoon, bales	lb.	.13½ – .14½
Dextrine, corn, bags 100	lb.	4.52 – 4.79
Gum, bags 100	lb.	4.82 – 5.09
Divi-divi, bags	ton	42.00 – 43.00
Fustic, sticks	ton	30.00 – 35.00
Chips, bags	lb.	.04 – .05
Gambier com., bags	lb.	.14½ – .15
Logwood, sticks	ton	25.00 – 26.00
Chips, bags	lb.	.02½ – .03
Sumac, leaves, Sicily, bags	ton	170 00 – 180.00
Domestic, bags	ton	50.00 – 55.00
Starch, corn, bags 100	lb.	3.87 – 4.14

Extracts

Archil, conc., bbl.	lb.	$0.16 – $0.19
Chestnut, 25% tannin, tanks.	lb.	.01½ – .02¼
Divi-divi, 25% tannin, bbl.	lb.	.05 – .05
Fustic, liquid, 42°, bbl.	lb.	.08 – .09½
Gambier, liq., 25% tannin, bbl.	lb.	.11 – .11
Hematine crys., bbl.	lb.	.14 – .18
Hemlock, 25% tannin, bbl.	lb.	.03½ – .04
Hypernic, liquid, 51°, bbl.	lb.	.12 – .13
Logwood, crys., bbl.	lb.	.14 – .15
Liq., 51°, bbl.	lb.	.07½ – .08½
Osage Orange, 51°, liquid, bbl.	lb.	.07 – .08
Quebracho, solid, 65% tannin, bbl.	lb.	.04½ – .04¾
Sumac, dom., 51°, bbl.	lb.	.06½ – .06¾

Dry Colors

Blacks–Carbongas, bags, f.o.b. works, contract	lb.	$0.09 – $0.11
spot, cases	lb.	.12 – .16
Lampblack, bbl.	lb.	.12 – .40
Mineral, bulk	ton	35.00 – 45.00
Blues–Prussian, bbl.	lb.	.36 – .37
Ultramarine, bbl.	lb.	.07 – .35
Browns, Sienna, Ital., bbl.	lb.	.05 – .12
Sienna, Domestic, bbl.	lb.	.03 – .03½
Umber, Turkey, bbl.	lb.	.04 – .04½
Greens-Chrome, C.P.Light, bbl.	lb.	.28 – .30
Chrome, commercial, bbl.	lb.	.10½ – .11½
Paris, bulk	lb.	.24 – .26
Reds, Carmine No. 40, tins	lb.	4.25 – 4.50
Iron oxide red, casks	lb.	.08 – .12
Para toner, kegs	lb.	.95 – 1.00
Vermilion, English, bbl.	lb.	1.30 – 1.35
Yellow, Chrome, C.P. bbls.	lb.	.17 – .17½
Ocher, French, casks	lb.	.02 – .03

Waxes

Beeswax, crude, Afr. bg.	lb.	$0.28½ – $0 29
Refined, light, bags	lb.	.32 – .34
Candellila, bags	lb.	.26 – .27
Carnauba, No. 1, bags	lb.	.34 – .35
No. 2, North Country, bags	lb.	.24 – .25
No. 3, North Country, bags	lb.	.21 – .22
Japan, cases	lb.	$0.16½ – $0.17
Montan, crude, bags	lb.	.06 – .06½
Paraffine, crude, match, 105-110 m.p., bbl.	lb.	.06½ – .06½
Crude, scale 124-126 m.p. bags	lb.	.05½ – .05¾
Ref., 118-120 m.p. bags	lb.	.06 – .06½
Ref., 123-125 m.p., bags	lb.	.06½ – .06¾
Stearic acid, sgle. pressed, bags	lb.	.11 – .11½
Double pressed, bags	lb.	.11½ – .12

Fertilizers

Acid phosphate, 16%, wks.	ton	$7.50 – $7.75
Ammonium sulphate, bulk f.o.b. works 100	lb.	2.70 – 2.75
Blood, dried, bulk	unit	4.10 – 4.15
Bone, raw, 3 and 50, ground.	ton	26.00 – 28.00
Fish scrap, dom., dried, wks.	unit	4.50 – .....
Nitrate of soda, bags 100	lb.	2.40 – .....
Tankage, high grade, f.o.b. Chicago	unit	2.75 – 3.00
Phosphate rock, f.o.b. mines Florida pebble, 68-72%	ton	3.25 – 3.70
Tennessee, 75%	ton	6.75 – 7.00
Potassium muriate, 80%, bags	ton	34.55 – .....
Sulphate, bags, 90%	ton	45.85 – .....
Double manure salt, bgs.	ton	26.35 – .....
Kainit, 14%, bgs	ton	10.25 – .....

Crude Rubber

Para—Upriver fine	lb.	$0.31½ – .....
Upriver coarse.	lb.	.21½ – .....
Plantation—First latex crepe	lb.	.31½ – .....
Ribbed smoked sheets	lb.	.31 – .....

Gums

Copal, Congo, amber, bags	lb.	$0.08 – $0.10
East Indian, bold, bags	lb.	.13 – .14
Manila, amber, bags	lb.	.14 – .16
Damar, Batavia, cases	lb.	.24 – .24½
Singapore, No. 1, cases	lb.	.27 – .28
Singapore, No. 2, cases	lb.	.18 – .18½
Kauri, No. 1, cases	lb.	.58 – .64
Ordinary chips, cases	lb.	.21 – .22
Manjak, Barbados, bags	lb.	.06 – .09

Shellac

Shellac, orange fine, bags	lb.	$0.66 – $0.67
Orange superfine, bags	lb.	.68 – .69
Bleached, bonedry	lb.	.74 – .75
T. N., bags	lb.	.64 – .65

Miscellaneous Materials

Asbestos, crude No. 1 f.o.b., Quebec	sh. ton	$300.00 – $350.00
Shingle, f.o.b., Quebec	sh. ton	50.00 – 60.00
Cement, f.o.b., Quebec	sh. ton	15.00 – 20.00
Barytes, grd., white, f.o.b. mills, bbl.	net ton	17.00 – 17.50
Grd., off-color, f.o.b., Balt	net ton	13.00 – 14.00
Floated, f.o.b., St. Louis, bbl.	net ton	23.00 – 24.00
Crude f.o.b. mines, bulk	net ton	8.00 – 9.00
Casein, bbl., tech.	lb	.11 – .12½
China clay (kaolin) crude, No. 1, f.o.b. Ga.	net ton	7.00 – 8.00
Powd., f.o.b. Ga.	net ton	14.00 – 20.00
Crude, f.o.b. Va.	net ton	6.00 – 8.00
Ground, f.o.b. Va.	net ton	13.00 – 19.00
Imp., powd.	net ton	45.00 – 50.00
Feldspar, No. 1 f.o.b. N.C.	long ton	6.50 – 7.25
No. 2 f.o.b. N.C.	long ton	4.50 – 5.00
No. 1 gr'd. N.C.	long ton	15.32 – 21.00
No. 1 Canadian, f.o.b., mill, powd.	long ton	20.00 – .....
Graphite, Ceylon, lump, first quality, bbl.	lb.	.05½ – .06
High grade amorphous crude	ton	15.00 – 35.00
Gum arabic, amber, sorts, bags	lb.	.12 – .12
Tragacanth, sorts, bags	lb.	.50 – .55
No. 1, bags	lb.	1.20 – .....
Kieselguhr, f.o.b. Cal.	ton	40.00 – 42.00
F.o.b. N.Y.	ton	50.00 – 55.00
Magnesite, calcined	ton	32.00 – 35.00
Pumice stone, imp., casks	lb.	.03 – .40
Dom., lump, bbl.	lb.	.06 – .08
Dom., ground, bbl.	lb.	.03 – .05
Silica, glass sand, f.o.b. Ind.	ton	2.00 – 2.25
Sand blast, f.o.b. Ind.	ton	2.25 – 3.50
Amorphous, 200-mesh, f.o.b. Ill.	ton	20.00 – .....
Glass sand, f.o.b. Ill.	ton	2.00 – 2.50
Soapstone, coarse, f.o.b., Vt., bags	ton	7.50 – 8.00
Talc. 200 mesh, f.o.b., Vt., bags, extra	ton	10.50 – .....
200 mesh, f.o.b., Ga.	ton	9.50 – 10.00
325 mesh, f.o.b. New York, grade A	ton	14.75 – .....

Mineral Oils

Crude, at Wells

Pennsylvania	bbl.	$2.75 – $2.85
Corning	bbl.	1.50 – .....
Cabell	bbl.	1.45 – .....
Somerset	bbl.	1.55 – .....
Illinois	bbl.	1.37 – .....
Indiana	bbl.	1.38 – .....
Kansas and Okla. under 28 deg.	bbl.	.75 – .85
California, 35 deg. and up	bbl.	1.40 – .....

Gasoline, Etc.

Motor gasoline steel bbls.	gal.	$0.14 – .....
Naphtha, V. M. & P. deod, steel bbls.	gal.	.13 – .....
Kerosene, ref. tank wagon	gal.	.13 – .....
Bulk, W.W. delivered, N.Y.	gal.	.08½ – .....
Lubricating oils:		
Cylinder, Penn., filtered	gal.	.33 – $0.36
Bloomless, 30@31 grav.	gal.	.24 – .....
Paraffin, pale 885 vis.	gal.	.15½ – .16½
Spindle, 200, pale	gal.	.21 – .21½
Petrolatum, amber, bbls.	lb.	.04½ – .04¾
Paraffine wax (see waxes)		

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	1,000	$140–$145
Chrome brick, f.o.b. Eastern shipping points	ton	45–47
Chrome cement, 40-50% Cr_2O_3	ton	23–27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23.00
Fireclay brick, 1st. quality, 9-in. shapes, f.o.b. Ky. wks.	1,000	40–43
2nd. quality, 9-in. shapes, f.o.b. wks.	1,000	33–37
Magnesite brick, 9-in. straight (f.o.b. wks)	ton	65–68
9-in. arches, wedges and keys	ton	80–85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48–50
9-in. sizes, f.o.b., Birmingham.	1,000	48–50
F.o.b. Mt. Union, Pa.	1,000	35–38
Silicon carbide refract brick, 9-in.	1,000	1,180.00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls	ton	$200.00 – ......
Ferrochromium, per lb. of Cr, 1-2% C.	lb.	.30 – ......
4-6% C	lb.	.12½ – ......
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	100.00 – ......
Spiegeleisen, 19-21% Mn.	gr. ton	33.00 – 35.00
Ferromolybdenum, 50-60% Mo, per lb. Mo.	lb.	2.00 – 2.25
Ferrosilicon, 10-12%	gr. ton	39.50 – 43.50
50%	gr. ton	72.00 – 75.00
Ferrotungsten, 70-80% per lb. of W	lb.	.88 – .90
Ferro-uranium, 35-50%, of U, per lb. of U	lb.	4.50 – ......
Ferrovanadium, 30-40%, per lb. of V	lb.	3.25 – 3.75

Ores and Mineral Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	$5.50 – $8.75
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 – .....
C.i.f. Atlantic seaboard	ton	18.50 – 24.00
Coke, fdry., f.o.b. ovens	ton	4.00 – 4.50
Coke, furnace, f.o.b. ovens	ton	3.00 – 3.10
Fluorspar, gravel, f.o.b. mines, Illinois	ton	17.50 – 18.50
Ilmenite, 52% TiO_2 Va.	lb.	.01½ – .....
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.41 – .45
Manganese ore, chemical (MnO_2)	ton	75.00 – 80.00
Molybdenite 85% MoS_2, per lb. Mo S_2, N. Y.	lb.	.70 – .75
Monazite, per unit of ThO_2, c.i.f., Atl. seaport	lb.	.06 – .08
Pyrites, Span., fines, c.i.f. Atl. seaport	unit	.11½ – .12
Pyrites, Span., furnace size, c.i.f. Atl. seaport	unit	.12 – .....
Pyrites, dom. fines, f.o.b. mines, Ga.	unit	.12 – .....
Rutile, 94@96% TiO_2	lb.	.12 – .15
Tungsten ore, scheelite, 60% WO_3 and over	unit	9.00 – .....
Tungsten, wolframite, white, 60% WO_3	unit	8.50 – 8.75
Uranium ore (carnotite) per lb. of U_3O_8	lb.	3.50 – 3.75
Uranium oxide, 96% per lb. U_3O_8	lb.	12.25 – 12.50
Vanadium pentoxide, 99%	lb.	12.50 – 14.00
Vanadium ore, per lb. V_2O_5	lb.	1.00 – 1.25
Zircon, 99%	lb.	.06 – .07

Non-Ferrous Metals

Copper, electrolytic	lb.	$0.13½ – $0.13¾
Aluminum, 98 to 99%	lb.	.27 – .28
Antimony, wholesale, Chinese and Japanese	lb.	.11½ – .11½
Nickel, 99%	lb.	.29 – .30
Monel metal, shot and blocks	lb.	.32
Tin, 5-ton lots, Straits	lb.	.49¾
Lead, New York, spot	lb.	.08
Zinc, spot, New York	lb.	.0665
Silver (commercial)	oz.	.71½
Cadmium	lb.	.60
Bismuth (508 lb. lots.)	lb.	1.85 1 90
Cobalt	lb.	2.50–3.00
Magnesium, ingots, 99%	lb.	.90–95
Platinum, refined	oz.	118.00
Mercury 75	lb.	71.00
Tungsten powder	lb.	.95–1.00

Industrial Developments of the Week

New Construction and Machinery Requirements in the Process Industries

Some Opportunities This Week

Alcohol .... Philadelphia, Pa.
Aluminum .... Chilton, Wis.
Aluminum .... Waukesha, Wis.
Cannery .... Athens, Wis.
Chemical plant .... Modesto, Calif.
Chemical plant .... Oakland, Calif.
Chemical plant .... Bridgeport, Conn.
Chlorine gas .... Dartmouth, N. S.
Enameling .... West Lafayette, Ohio
Fertilizer .... Spartanburg, S. C.
Glass .... Connellsville, Pa.
Hosiery mill .... Des Moines, Ia.
Milk products .... Vancouver, B. C.
Paper .... Rhinelander, Wis.
Paper .... Three Rivers, Que.
Physics and Chemistry dept. ...Petrolea, Ont.
Precipitation plant .... Peru, S. A.

New England

Conn., Bridgeport—The American Chain Co., 829 Connecticut Ave., awarded the contract for the construction of a 2 story and basement, 42 x 52 ft. chemical laboratory on Hollister Ave., to T. J. Pardy Construction Co., 1481 Seaview Ave. Estimated cost $40,000. Owner is in the market for miscellaneous chemical equipment for the testing of steel, etc.

Middle Atlantic

N. J., New Brunswick—City Commission, E. J. McLaughlin, City Clk., will receive bids until Oct. 28 for 200 tons sulphate of alumina containing no free acid, 100 tons light soda ash containing not less than 98% pure sodium carbonate, 200 tons No. 1, chemical hydrated lime. A. Atkinson, is engineer.

Pa., Connellsville — Capston Glass Co., awarded the contract for a 1 story addition to glass plant, estimated cost $50,000. Austin Co., 16112 Euclid Ave., Cleveland, Ohio, is architect and contractor.

Pa., Philadelphia—Publicker Commercial Alcohol Co., Swanson and Delaware Ave., plans the construction of 8 manufacturing buildings, from 2 to 8 stories, various sizes, on Delaware Ave. and Bigler St. Estimated cost $2,000,000. C. E. Wunder, 1520 Locust St., is architect.

South

S. C., Spartanburg—The International Agricultural Association, 61 Broadway, New York, awarded the contract for the construction of a fertilizer plant, estimated cost $125,000. This mill is to replace the plant destroyed by fire some months ago. Will manufacture its own acids and phosphates. Hugger Bros., Atlanta, Ga., are contractors.

S. C., Union — The Excelsior Mills, awarded the contract for the construction of a weave shed to H. J. Howitz, Greenville. Estimated cost $40,000. Owner is in the market for humidifying equipment and steam heating apparatus.

Tenn., Nashville — Buenavista Spring Sanitorium Co., White City Pk., plans the construction of a 100 room sanitorium, including laboratories, etc. Estimated cost $300,000.

Middle West

O., Leetonia — Hanna Furnace Co. had plans prepared for extensive improvements to their plant increasing the capacity 10 to 15%. New steel two track trestles with aerial recarriers will be installed, also a crane with 900 ft. beam, etc.

O., West Lafayette — Moore Enameling & Mfg. Co., H. A. Sicker, Mgr., is in the market for enameling equipment for the manufacture of kitchen ware and general enameling.

Wis., Athens—Athens Canning Co., will build a 2 story, 50 x 110 ft. cannery, also 66 x 128 ft. warehouse. Estimated cost $75,000. Private plans. Owner is in the market for canning and conveying machinery.

Wis., Chilton—Aluminum Specialty Co., 17th and Wollmer Sts., Manitowoc, awarded the contract for the construction of a 2 story and basement, 62 x 100 ft. factory, to W. H. Mielke, 1331 South 10th St., Manitowoc. Estimated cost $50,000. Owner is in the market for heavy presses, rolls, etc.

Wis., Rhinelander—The Daniels Mfg. Co., awarded the contract for the construction of a 1 story and basement, 60 x 200 ft. paper converting plant, to Kalman Steel Co., Milwaukee. Estimated cost $80,000.

Wis., Waukesha — Quality Aluminum Castings Co., Lincoln Ave., A. Pankratz, Mgr., is receiving bids for a 1 story addition to factory. Private plans. Owner is in the market for aluminum working machinery, presses, etc.

West of Mississippi

Ia., Des Moines — The Rollins Hosiery Mills, is having plans prepared for the construction of a 1 story and basement, 65 x 100 ft. mill. Estimated cost $50,000. Lockwood, Greene & Co., 38 South Dearborn, Chicago, Ill., are architects and engineers. Owner is in the market for humidifying equipment and steam heating apparatus.

Far West

Calif., Bell—Trustees of Huntington Park High School Dist., will receive bids until Oct. 27 for the construction of a high school, including complete refrigeration and laboratory equipment. Estimated cost $250,000. Train & Williams, 222 Western Mutual Life Bldg., 321 West 3rd St., Los Angeles, are architects.

Calif., Modesto—D. V. O. Products Co., c/o Chamber of Commerce, plans the construction of the 1st and 2nd units, 80 x 100 ft. and 92 x 140 ft. of a chemical plant. Estimated cost $200,000. C. E. Gilman, engineer in charge of construction.

Calif., Oakland—Clorax Chemical Corp., 850 42nd St., had plans prepared for the construction of a 2 story chemical plant on East 42nd St. near Warren St. Estimated cost $15,000.

Canada

B. C., Vancouver—Fraser Valley Milk Products Association, 8th Ave., and Yukon Sts., will soon receive bids for the construction of a 3 story and basement, 60 x 122 ft. dairy building; 1 story and basement, 73 x 122 ft. garage; 3 story, 100 x 120 ft. stable, total estimated cost $131,500, a utility plant at Chilliwack, cost $36,000. Owner is also receiving bids on refrigeration plant and installation at Vancouver, cost $11,000; 600 hp. boiler and power plant, milk powder plant, equipment etc., at Chilliwack, cost $28,000 or $40,000 respectively. P. P. Brown, 410 London Bldg., is engineer.

N. S., Dartmouth — The City, Mayor Mosher, plans to purchase a chlorine gas plant including motors and 3 pumps.

Ont., Petrolea—Bd. of Education, J. B. Dale and R. Kirkpatrick, Committee, plan the construction of a new high school and to equip the physics and chemistry departments. Bylaw will be voted on soon.

Que., Three Rivers—International Paper Co., Pershing Square Bldg., New York, plans an addition to its plant. Estimated cost $5,000,000. F. White, New York is engineer.

South America

S. A, Peru—Cerro de Pasco Copper Corporation, 15 Broad St., New York, is having preliminary plans prepared for steel work and equipment for flue tupe Cottrell precipitation plant for treating converter gases, etc. Estimated cost $300,000. Private plans.

Reports Not Yet Verified

Ill., Chicago—The Domestic & Foreign Commerce Dept., Chicago Association of Commerce, 10 South LaSalle St., has received an inquiry from a company in Havana, Cuba, desiring to get in touch with American manufacturers of sugar mill machinery and supplies. No. 4094.

Ind., Indianapolis—The Western Brass Works, has leased property at 1006 South Holmes Ave., and will operate a foundry for the production of brass and bronze castings, etc.

Mass., Waltham—The Bettinger Enamel Corporation, River St., plans the construction of a 1 story, 72 x 80 ft. plant on Pleasant St.

Mass., Woburn—Woburn Degreasing Co., manufacturers of oils, greases, etc., plans to rebuild their plant recently destroyed by fire.

Minn., East Grand Forks—The Red River Sugar Co., 416 Oak Grove St., Minneapolis, will soon receive bids for the construction of a beet sugar refining plant, including power house and machine shop, cost to exceed $300,000. H. A. Douglas is president.

Miss., Gulfport—Wood Products Co., recently organized by W. B. Lundy and S. L. McGlathery, Pass Christian, and others, plans the construction of a plant to utilize yellow pine stumps in the manufacture of spirits of turpentine, pine oil, rosin, etc., in making high grade white paper, also plans to establish plants in other sections.

N. J., Pennsville—The E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., has construction under way on a 5 story, 68 x 140 ft. plant at Deep Water Point for exclusive use in the manufacturing of ethyl gas, a new fuel for automobiles. The plant will be used by the Ethyl Gasoline Co., a subsidiary of the du Pont corporation.

O., Elyria—The Worthington Ball Co., is having plans prepared for a 2 story addition to factory for the manufacture of golf balls.

Industrial Notes

The Duriron Co., Inc., Dayton, Ohio, has concluded arrangements with the Industrial Equipment Co. of Buffalo to represent it in Buffalo and vicinity. The Industrial Equipment Co. is composed of G. G. Crewson, formerly connected with E. I. du Pont de Nemours & Co. and with the National Aniline & Chemical Co., and A. E. Smith, formerly of the Solvay Process Co. and the National Aniline & Chemical Co.

At the annual meeting of the Johnston Glass Co., Hartford City, Ind., John R. Johnston of Pittsburgh, Pa., was named president, John Jay, of Kokomo, Ind., vice-president and George Fulton of Hartford City, Ind., secretary and treasurer.

The Salmen Brick & Lumber Co. of Slidell and New Orleans, La., has been bought by the Standard Brick & Clay Products Co., Inc. Thomas T. Parker is president and general manager, J. D. O'Keefe secretary and treasurer, with Lester F. Alexander, Fred W. Salmen, W. H. Williams, J. L. Dickey, of New Orleans, and J. A. Mercier, of Detroit. The New Orleans office of the company will be at 913 Whitney Place and plant office at Slidell.

The Humboldt Sulphur Co. has been incorporated at Wilmington, Del., with an authorized capital stock of $6,800,000.

The Highland Refractories of Clearfield, Pa., has changed its name to the Highland Clay Products Co.